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**HOW ICE AGE
MEGA-LAKES
ONCE FILLED
THE SAHARA**

**THE ORIGIN OF LARGE,
CURVED MOUNTAIN BELTS
AND ISLAND ARCS**

HUMAN AND OCTOPUS

**BRAIN SIMILARITY:
COMMON ANCESTRY *OR* DESIGN?**

**WORD USE PATTERNS IN GENESIS 1
THWART FRAMEWORK HYPOTHESIS**

**HOW DARWINIAN IDEAS DROVE THE NAZI POLICY
OF TERRITORIAL EXPANSION IN WORLD WAR II**



JOURNAL OF CREATION

An international journal devoted to the presentation and discussion of technical aspects of the sciences such as geology, biology, astronomy, etc., and also geography, archaeology, biblical history, philosophy, etc., as they relate to the study of biblical creation and Noah's Flood.

COVER: The giant Pacific octopus (*Enteroctopus dofleini*)

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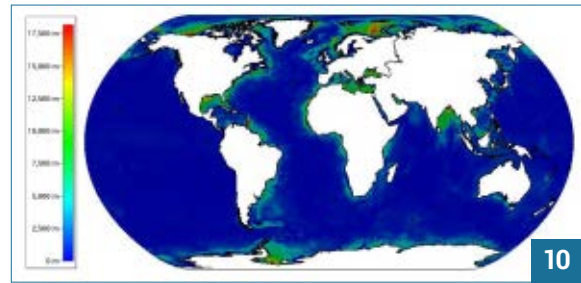
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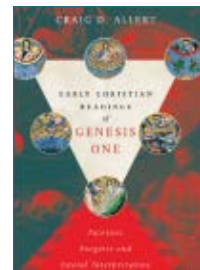
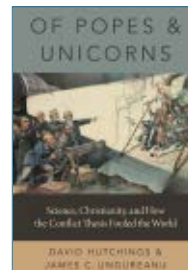
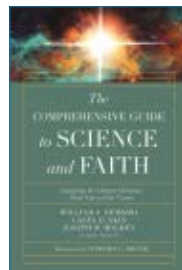
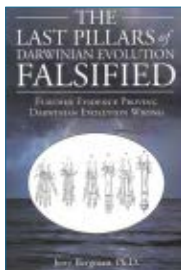
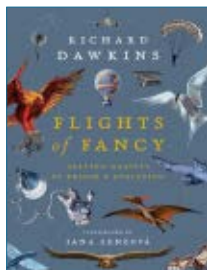
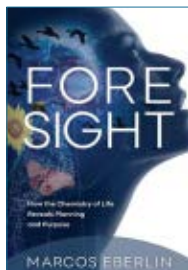
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ABOUT US

**What is Creation Ministries International?**

Creation Ministries International is an independent, non-profit, non-denominational organization, controlled by Christians in the fields of science and education, committed to researching, developing, and promoting Christian creationist materials, and Christian school texts and aids. Our work is based on acceptance of:

- » The Bible is the written Word of God. It is divinely inspired and inerrant throughout.
- » The final guide to the interpretation of Scripture is Scripture itself.
- » The account of origins presented in Genesis is a simple but factual presentation of actual

events and therefore provides a reliable framework for scientific research into the question of the origin and history of life, mankind, the earth and the universe.

- » Scripture teaches a recent origin for man and the whole creation.
- » The great Flood of Genesis was an actual historic event, worldwide (global) in its extent and effect.
- » The special creation of Adam (as one man) and Eve (as one woman) and their subsequent fall into sin, is the basis for the necessity of salvation for mankind (and thus for the Gospel of Jesus Christ).
- » The scientific aspects of creation are important, but are secondary in importance to the proclamation of the Gospel of Jesus Christ as Sovereign, Creator, Redeemer and Judge.

Please note that in all of this, we openly proclaim that our work is centred around Jesus Christ. We are convinced that the real needs of men and women can only be met by reconciliation to God through faith in and commitment to Jesus Christ the Creator, as Lord and Saviour.

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Marsupials in Australia—an act of God?

Graeme Taylor

How did Australia come to be inhabited by about 140 species of marsupial mammals and a couple of species of monotremes, but no placental terrestrial mammals (apart from rats, which may have been relatively late arrivals)? Creationists tend to avoid supernatural causes when explaining the post-Flood world's biogeography:

“Perhaps those marsupials only survived in Australia because they migrated there ahead of the placental mammals (we are not suggesting anything other than ‘random’ processes in choice of destination).”¹

A preference for looking first for natural causes has a sound basis.

“The absence of a flurry of capricious, ‘abracadabra-style’ miracles in the Bible (apocryphal gospels have an abundance of these) is actually one hallmark of its authenticity ... Having to postulate miracle after miracle, especially ones the Bible does not mention, would seem awkward and would in practice make the Bible account less believable to sceptics.”²

However, in the same article, Dr Wieland points out, concerning the loading of the Ark:

“The degree of supernatural specificity is so extensive ... Why not accept that God directly and supernaturally commanded the animals He wanted to travel to (and board) the Ark to do so?”²

How do (or should) creationists decide whether a natural or supernatural explanation is appropriate in a given situation? I suggest the following criteria:

A natural explanation should be used whenever a scientifically coherent account that doesn't contradict the Bible is possible. (Certainty isn't required, and the story can be expected to be modified in the light of further investigation and scientific knowledge.)

A supernatural explanation should be used:

1. when the Bible tells us that God directly made something happen, e.g. the events of Creation Week and the animals entering the Ark
2. when we recognize, because of the information requirement or other features of design, that the outcome we are observing must have been determined by an intelligent, super-humanly able actor.

Dr Don Batten gives several situations where we easily recognize that random chance doesn't explain what we see—a deck of cards is arranged in suits and in order, grains of sand are arranged in a line or a perfect square (presumably without constraining borders), more than 20 people in a line are arranged from shortest to tallest, the family members of a lottery supervisor consistently win the lottery. In each case it is reasonable to conclude that an intelligent actor, rather than natural causes or random chance, has been responsible.³

The presence in Australia (before human arrival) of about 140 species of marsupials, a couple of species of monotremes and rats, but no other placental mammals is an arrangement that looks too specified (or lopsided) to have occurred through natural processes. This should lead us to suspect that an intelligent actor, rather than natural causes or random chance, has been responsible. To echo the above quote, “the degree of ... specificity is so extensive ... Why not accept that God directly and supernaturally commanded the animals He wanted to travel to”² and become established in, Australia?

Creationists may fear that this approach will lead to accusations of god-of-the-gaps superstition, but

“... defaulting to naturalistic explanations without justification is equally as problematic and precarious as the god-of-the-gaps, yet no evolutionist ever seems to warn against making *that* mistake. Instead, they seem perfectly at home presuming naturalism, even when it defies common sense [emphasis in original].”⁴

Instead of defaulting to either of these positions, let's make sure truth and logic trump seeking credibility with scientists (see 1 Cor 1:17–2:4). While the naturalistic explanations suggested by creationists as to how mammals travelled from Ararat to Australia do demonstrate that such travel would have been physically possible, the explanations offered as to a selection mechanism that resulted in such a highly specified group of mammals arriving in Australia are implausible.

Difficulties with natural explanations

Endemism (a species being found in a single defined geographic location) and disjunct populations (two or more closely related taxa occurring in geographically separated areas) are primarily explained by evolutionists in terms of slow continental drift separating populations. This is allegedly followed by evolution into new species. A number of articles on CMI's website explore difficulties with this view, such as too little evolution in too much time (given the supposed length of time since the continents separated, the species on each should have diverged more than they have). Also, species which are ‘known’ to have evolved long after continental separation, are present in more than one of the separated continents. Evolutionists explain these anomalies by adding migration across land



Figure 1. Left, Solving Britain's convict problem—the main criterion for selection for transport to Australia in the early 19th century. Right, Why did marsupials become established in Australia?

bridges and transoceanic transport of animals on rafts of vegetation to their base theory. Both of these are favoured explanatory mechanisms of creationists. Additional mechanisms, to explain biogeographic distribution, are transport by man, extinction, and speciation.⁵ Again these mechanisms are accepted by both creationists and evolutionists (although each have their own understanding of speciation).

Creationist attempts to explain Australia's mammal population fall well short of convincing.

"Perhaps competition from placentals drove marsupials to migrate away from the Ark ahead of placentals. Marsupials then gained an early foothold in Australia and South America and, without competition from placentals, they thrived in those places. And perhaps, as the log rafts broke up and sea levels rose and covered the land bridges, Australia and South America became almost completely isolated before very many placentals had made their way to those continents."⁶

The Ark's population, without divine supervision, would have dispersed according to food availability, altitude and terrain preferences, and random choice. From Ararat they could have headed towards Europe, Africa, or Asia. The 140 species of marsupials in Australia are highly variable in size,

speed, and behaviour. They have been classified into 15 families and include carnivorous marsupial mice about 5 cm long and wolf-sized thylacines (Tasmanian tigers), nocturnal omnivorous bandicoots, insectivorous numbats, and herbivores such as wallabies, kangaroos up to 1.8 m tall, burrowing wombats, and tree-dwelling koalas and possums (including gliders).

Likewise, the almost 4,000 species of placental mammals, arranged in about 100 families, are diverse. The proposal that all marsupials migrated faster than all placentals because of competition is improbable. Did wombats, koalas, and possums really travel faster and further than antelope, deer, rabbits, and wolves? Competition implies depleted food supplies. As food supplies diminished, even if placentals were uniformly more able to survive on meagre rations, surely they would also be inclined to move to places with more abundant food.

Evidence that placentals always out-compete marsupials is lacking, since

"American marsupials continue to thrive in competition with placental mammals and exploit a wide range of diets, being fruit-eating, carnivorous, insectivorous, ant-eating, or grazing animals, and habitats, e.g. being arboreal, terrestrial or burrowing."⁷

Post-Flood predation?

One can imagine tigers and wolves, immediately following release from the Ark, rapidly causing the extinction of many kinds of erstwhile fellow travellers. Possible explanations for why this didn't happen include the suggestion that Noah delayed release of the carnivores to give vulnerable creatures time to disperse. Also, at the time of the Flood, the carnivores were closer to Edenic vegetarianism and possibly had adjusted to vegetarianism while on the Ark and "Exhumed carrion was likely a major food source for carnivores after the Flood".⁸ These proposals have explanatory power, but they remain conjectural. They require that fleet-footed carnivores remained close to the Ark until slow potential prey had migrated a considerable distance and multiplied. The proposals also imply that carnivorous marsupials (thylacines and Tasmanian devils) would have started from behind herbivorous placentals as they migrated away from Ararat.

Any explanation requiring all Australian marsupials plus the monotremes to have independently chosen to travel in the right direction and, at the right times, to have found and clambered aboard beached log mats, which then, in a timely fashion, embarked on a voyage towards Australia, strains credulity (figure 1).

For each species, at least a pregnant female or a mating pair would have needed sufficient food and water for survival during each stage of the perilous journey. This scenario also requires all placentals to have chosen not to travel the same routes as the marsupials, or to have died when they tried.

Biblical considerations

The Bible doesn't give explicit information about how biogeographical distribution occurred post-Flood. However, it is apparent that God selected and brought the animals to Noah and the Ark (Gen 7:8, 9). Presumably He chose creatures with great genetic diversity and purity as suitable breeding stock to replenish the earth. With modern livestock transport by sea and voyages lasting only weeks there are accidents and deaths among the animals.⁹ God would not have left the survival of animal kinds to random chance. It isn't unreasonable to suppose that He controlled aggression, disease and accidents during the voyage, loading and unloading.

Within God's whole plan for the re-establishment of creation following the Flood, perhaps he planned specific ecosystems, with the species of flora and fauna he had designed interrelating in selected geographic locations.

"The God who made the world and everything in it . . . From one man he made every nation of men, *that they should inhabit the whole earth*; and *he determined the times set for them and exact places where they should live* [emphases added]" (Acts 17:24, 26).

I suggest that the italicized parts of the previous quote also apply to "... every kind of living creature that is with you—the birds, the animals, and all the creatures that move along the ground—so they can multiply on the earth and be

fruitful and increase in number upon it" (Gen 8:17).

Jesus' statement that not one sparrow falls to the ground "apart from the will of your Father" (Matt 10:29), shows the attention God pays to individual creatures.

We can't know the method God used to ensure that the right creatures arrived in Australia, or over what range of times they arrived. However, this image (from Psalm 121) of the creator God caring for Israel provides a sense of His watchful, guiding, powerful patience:

"My help comes from the Lord, the Maker of heaven and earth.

He will not let your foot slip—he who watches over you will not slumber; indeed, he who watches over Israel will neither slumber nor sleep.

The Lord watches over you—the Lord is your shade at your right hand; the sun will not harm you by day, nor the moon by night.

The Lord will keep you from all harm—he will watch over your life; the Lord will watch over your coming and going both now and forevermore" (Ps 121:2–8; NIV).

From the outcome (marsupials and not placentals established in Australia), we can deduce that God kept successive generations of the 'chosen races' heading in the right direction, by land or by sea, and always enough survived for continuity. Similarly, He prevented placentals from becoming established in Australia.

Corollary

If it is granted that the post-Flood biology of Australia is best (perhaps only) explained in terms of God's direct plan and intervention, it is reasonable to suppose that all post-Flood biogeography was also God superintended. He certainly must have controlled placental competitors from arriving and surviving in Australia. With similar oversight He could have

directed them and other animals, birds, and plants to where they became established.

Debunking evolutionary explanations

Creationists have generally agreed with evolutionists that natural causes are sufficient to explain biogeographic distribution but claimed that "creationists are in a far better position to explain these animals as there was much more vegetation available for rafting immediately after the global Flood"¹⁰ and

"... evolutionary biogeographers are unable to provide an adequate mechanism by which these distribution patterns could have arisen by dispersal. In contrast, the data fit well within a creationist model where plants and animals were rafted to the places they now inhabit on log mats left over from the Genesis Flood."¹¹

However, by taking this stance, creationists are asserting that their natural causes are better than evolutionists' natural causes at explaining biogeography. This opens the door for evolutionists to counter with such claims as, for example: we have hundreds of millions of years available for a lot of large local floods, plus many ice ages to expose land bridges, plus tectonic continental shift, plus evolution taking place at different times in different locations etc, versus your one-off creation plus your one-off flood.

This isn't an easy debate for either side to win. Instead of conceding ground, we can assert that evolution is wrong because it contradicts the biblical account and because so many aspects of it are scientifically impossible (e.g. nobody has proposed a tenable natural way that any of the following could have occurred: the requisite proteins for the first cell, or DNA, or DNA arranged in a useful code, or structures that can read and

act on encoded DNA, or single-celled organisms transitioning to multi-celled, or asexual reproduction transitioning to sexual, etc.). So evolution-based explanations for biogeography are doomed to fail. The multiplicity of such explanations and the flaws and inadequacies that fellow evolutionary scientists have found in them testifies to this.^{10,11} However, biogeography can be explained by God-superintended post-Flood migration.

Lacking evidence to refute such a statement, the only avenue available to evolutionists is to repeat some version of their statement of belief, such as: we know science will eventually provide a naturalistic explanation because we don't believe in God or the Christian Bible.

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How accurate are marine microfossil transfer functions?

Michael J. Oard

Secular scientists apply uniformitarianism to almost everything that happened in the past. For instance, they are interested in past oceanic variables, especially sea surface temperature (SST), during their many ice ages or their warm periods of the Cretaceous and Cenozoic. It is widely believed the species composition of the marine plankton predicts SSTs. So, they use

present-day distributions as an analogue to calculate SSTs from fossil assemblages from deep-sea cores, applying straightforward uniformitarianism.

The development of transfer functions

Uniformitarian scientists have drilled thousands of deep-sea cores, which usually have microfossils. In order to determine what these microfossils mean in regard to environmental variables, they employ transfer functions.

Transfer functions commonly use foraminifera (figure 1), and the most common environmental variable of choice is SST. This is assumed to be either the temperature at the 10 m level or the average temperature over 75 m.¹ They measure present-day SSTs and take samples of the water and analyze

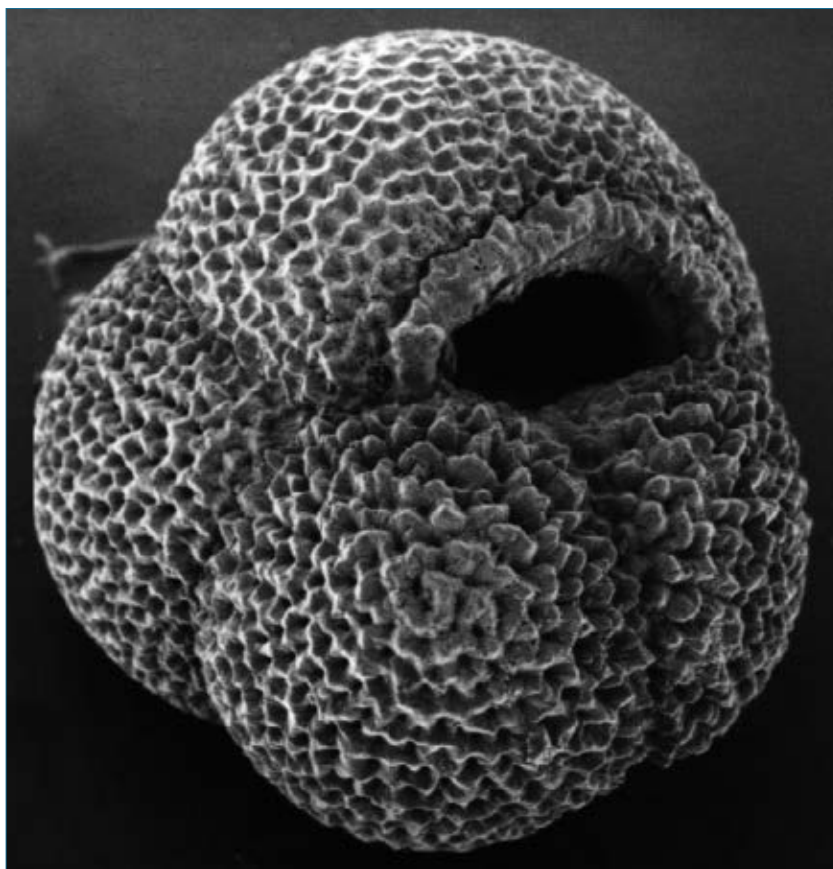


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Figure 1. A planktonic foraminifera skeleton

the foraminifera. In this way, they obtain a relationship, i.e. an equation, between SST and species distribution. This equation is then applied to the marine microfossils in the deep-sea cores to calculate past SSTs, which can be related to other paleoclimatic variables, such as atmospheric temperature.

Transfer functions can be inaccurate

A problem that has not been considered until recently is that the species of foraminifera used to develop the transfer function may bias the equation.² It is common practice to use as many species of foraminifera as possible, collected in the surface layer, to determine the transfer function. However, it is now known that “not all species are sensitive to temperature, and their distribution may be governed by other parameters.”³ The researchers discovered that a majority of the foraminifera do *not* carry useful temperature information, although those scientists who developed the transfer function have assumed all, or nearly all, do contain useful information. They also found that transfer functions, developed with a smaller sample of species, resulted in different SSTs. And the difference is not trivial: “The differences can be up to several degrees Celsius and variable in time and space, with important implications for paleoceanographic interpretations.”⁴ It also “adds a previously unrecognized source of uncertainty to quantitative assemblage-based reconstructions.”⁵

Thus, only a small number of species appear to indicate SSTs. Some of the taxa have a neutral effect, while other species included can have a major effect on the transfer function. It may be difficult to determine which foraminifera should be used. Various combinations of species could be used, but it would be difficult to decide which transfer function is correct without ‘independent’ information: “Taken

at face value and in the absence of independent evidence, such inherent ambiguity renders it impossible to decide which of the reconstructions is more realistic.”⁵ At this point in time (2022), the uncertainty cannot be determined for any transfer function. Therefore, all transfer functions must be viewed with caution. These results not only apply to foraminifera and SSTs, but also other planktonic micro-organisms and other paleoecological reconstructions.

Need more understanding for microorganisms and their fossils

The researchers believe that they also “need a more mechanistic understanding of the factors that determine species assemblage composition in the sediments.”⁶ Species inhabit certain vertical and seasonably distinct habitats, “adding even more complexity to deriving a single environmental variable from an assemblage of different species.”⁶ In fact, it is now known that planktonic foraminifera live in a broad depth range.¹ And since oceanic temperatures decrease downward, especially in the tropics, this vertical zonation can have a drastic effect on species abundance. So, species abundance of planktonic foraminifera is a poor measure of SSTs.

Then there is the problem that ocean temperatures were different from today during glaciation or during supposed warm periods. This temporal change can cause different species abundances that would not be picked up with a transfer function. For instance, different species abundances in the South China Sea during the last glacial maximum are unique, with no modern analogues, throwing off transfer functions developed from present-day distributions.⁷ The transfer functions gave glacial SSTs about the same as today or a little warmer, while geochemical information and terrestrial

proxies gave temperatures 2–5°C cooler than today. One would think such results would disqualify the use of transfer function to determine past conditions.

There are additional ecological and geological processes on the bottom of the ocean that can affect the fossil foraminifera composition,³ throwing off transfer function deductions. Some of these variables are variable shell dissolution deep in the ocean and even within the sediment.⁸ Also, bottom currents can erode micro-organisms and deposit them elsewhere, and bioturbation can mix the sediments.⁹

Creation scientists should be aware that the uniformitarian quantitative estimates of past paleoenvironmental variables using transfer functions can be off considerably. This should make us wary of uniformitarian paleoceanographic deductions.

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Ice Age megalakes did exist in the Sahara

Michael J. Oard

Researchers have long known that the Sahara Desert was once wet (or ‘green’^{1,2}). However, there is a question as to when it happened and how wet it became. They believe the Sahara was green very late in the Ice Age and the early Holocene—a period dubbed the African Humid Period (AHP).³ Field research and satellite pictures provide evidence of lakes and rivers that are now mostly buried beneath the sand.^{4–6} Paleolake Chad covered an area of 340,000 km²,⁷ much larger than the current Lake Chad (figure 1). Countless fossils from the Ice Age have been found, such as snails, diatoms, ostracodes, fish, foraminifera, elephants, giraffes, buffaloes, antelopes, rhinoceroses, large reptiles, and other animals, including the aquatic hippopotamus.⁸ This kind of diversity is seen today in the African Serengeti, south of the Sahara Desert. Even dwarf Nile River crocodiles have been found as recently as the early 20th century in isolated lakes or pools in oases of the high western Sahara.^{9,10} This suggests the Sahara was wet recently. Moreover, many Ice Age artifacts and thousands of rock petroglyphs have been found, suggesting the population of the Sahara was quite large.

Some researchers downplay the wet Sahara

However, some researchers propose there were no megalakes (defined as lake areas greater than 25,000 km²) other than Paleolake Chad, which is fed by rain from the belt of higher precipitation to the south. Instead,

they argue there were wetlands and small lakes, suggesting that the wet Sahara may not have been as wet as some suppose.¹¹ Quade *et al.* suggest that if megalakes existed, it would have required an annual precipitation rate greater than 1.2 m/yr with the Intertropical Convergence zone (ITCZ) displaced greater than 1,000 km north of its current location. Models do not support such a shift of the ITCZ. Because of the models, Quade *et al.* suggest that the evidence for megalakes can be explained by isolated wetlands and small lakes caused by springs. As proof, they claim that there is a lack of well-developed and spatially extensive shorelines.

At present the ITCZ causes an east–west belt of heavy rain through central Africa. It is known that the precipitation for the green Sahara came from the ITCZ because the

oxygen isotope ratios in the water were high.¹² Although secular scientists are mystified,¹³ the green Sahara can be explained within biblical earth history if the Northern Hemisphere ice sheets melted well before the maximum of the Ice Age on Antarctica.¹² The ITCZ would then have been further north until after glacial maximum in Antarctic 1,000 years after the Flood.

New research vindicates the existence of megalakes

The article by Quade *et al.* spurred research to re-examine the evidence for Sahara megalakes.¹⁴ The researchers not only validated the existence of many megalakes throughout the Sahara, even in the north, they also discovered a new one in the western Sahara, named Lake Timbuktu. They also found many smaller lakes

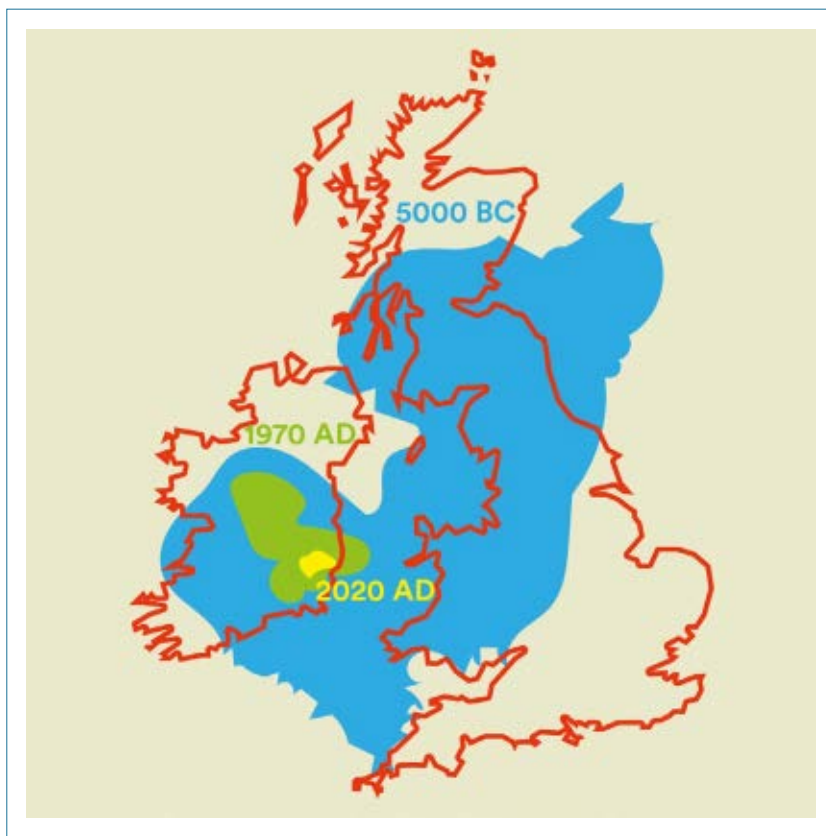


Figure 1. Lake Chad in 1970 (green) compared with its size during the AHP 7,000 years ago (blue) and the size of the British Isles (red). Lake Chad has shrunk considerably in the last 50 years (yellow area), likely because of increasing demand for water.

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and rivers. Shorelines are not well developed or extensive because moving sand dunes have destroyed most of the geomorphic evidence. The researchers used comprehensive remote sensing of megalake shorelines and their catchments to analyze the megalakes. Sometimes only remnants of shorelines were detected, which showed that high shorelines did exist and proved that megalakes were common and vast. Most of the Sahara basins give evidence of megalakes. Shoreline features cannot be attributed to springs, since springs do not form shorelines.

Timing of megalakes uncertain

Drake *et al.* realize that the dates of the megalakes are uncertain: “However, it is clear from the literature that the timing of the development of many of these megalakes is poorly constrained.”¹⁵ They place the megalakes generally into the uniformitarian Quaternary, 2.6 Ma to 11.7 ka, i.e. their general ice age period. More specifically, they place the existence of megalakes during ‘humid phases’ of the previous interglacial. However, they admit that there is little datable material to substantiate this concretely. The dates used are derived from carbon-14 and U-series techniques used on fossils shells, but these methods are said to be notoriously unreliable for dating fossil shells. Although luminescence techniques could potentially date quartz-rich sand shorelines, it has been applied only in a few locations.

Researchers still do not know origin of wet Sahara

In regard to the needed precipitation to fill up the paleolakes, Drake *et al.* admit that the models fail. They try to justify the existence of many megalakes by claiming that many catchments contain mountains, and that more precipitation is expected in the mountains, which is true. However, today the Sahara has mountains and basins, but the Sahara is very far

from producing megalakes, with the exception of Lake Chad. Although Drake *et al.* show that the existence of megalakes is robust, they skirt around the ‘elephant in the room’: why was there much more precipitation than there is today?

The Ice Age solution

The biblical rapid Ice Age model can explain the existence of the large and small lakes in the Sahara and the population of animals and people by a northward displacement of the ITCZ.^{1,2} In the same way as were the lakes in the southwestern U.S., and other lakes generally around the 30th parallel of the Northern Hemisphere, the Saharan lakes were first filled during Flood runoff. Residual floodwater would have been left in enclosed basins. Evidence for this could be the marine foraminifera fossils found in the Sahara Desert. Then much more rain in the Sahara during the Ice Age would have either maintained the lakes or filled them up to overflowing, resulting in rivers and streams. Dried-up rivers and streams with amphibian fossils are found below the sand. Such a wet environment was caused by much greater evaporation from the Ice Age warm ocean and a different general circulation from that evident today. But the wet Sahara continued after the Ice Age into the mid Holocene, likely because the ITCZ was displaced much farther north.

Conclusion

The notion of a ‘wet Sahara’ in the recent past is controversial among secular researchers, since they struggle to adduce a mechanism to explain it. However, much evidence exists for it and has recently been bolstered through the discovery of ancient shorelines. And unlike the conditions proposed by secular researchers, the conditions produced by a post-Flood Ice Age in the biblical perspective provide mechanisms for explaining the existence of a ‘wet Sahara’.

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Enormous erosion of the continents during the Recessive Stage of the Flood

Michael J. Oard

During the Recessive Stage of the Flood,¹ the continents rose differentially as the ocean basins sank.^{2,3} The bulk of the sediments were deposited within 150 days during the Inundatory Stage, followed by massive erosion during the Recessive Stage of the Flood. The increasing potential energy of the floodwaters during differential vertical tectonics would create powerful currents and rapid erosion in some areas.

Sediment accumulation during Flood runoff

During the Abative Phase, eroded sediments were carried in wide currents, perhaps 2,000 km wide, and deposited when they reached deep water, forming the continental

Table 1. The sediments in the three divisions of the ocean⁷: (1) the continental margins, (2) the area between the margins and the deep ocean, and (3) the deep ocean. The area of the deep ocean is defined as the area 200 km oceanward of the subsurface continent/ocean boundary. (N.B.: The values labelled "In between margins and deep ocean" were calculated from data in Straume *et al.*,⁷ whereas the other data in table 1 was directly drawn from this paper.)

Particular area	Oceanic area	Volume of sediments	Average thickness
Whole ocean	$3.63 \times 10^8 \text{ km}^2$	$3.37 \times 10^8 \text{ km}^3$	927 m
Continental margins	$0.47 \times 10^8 \text{ km}^2$	$1.43 \times 10^8 \text{ km}^3$	3,044 m
In between margins and deep ocean	$0.37 \times 10^8 \text{ km}^2$	$0.81 \times 10^8 \text{ km}^3$	2,189 m
Deep ocean	$2.79 \times 10^8 \text{ km}^2$	$1.13 \times 10^8 \text{ km}^3$	404 m

shelf, slope, and in some areas the rise.⁴ Thick sediments accumulated along the margins, especially in the Gulf of Mexico, off the east coast of North America, in the Bay of Bengal, off the south coast of Australia, in the Mediterranean Sea, and along the Arctic coast. Off the east coast of North America, the sediments accumulated at depths greater than 18 km, the bottom sediments of which were deposited in deep rift basins.⁵ As the Flood runoff channelized, the velocity accelerated and carved valleys and canyons on the continents and deep submarine canyons in the continental margin sediments.

A recent estimate of oceanic sediments

How much erosion occurred after the peak of the Flood? This erosion can be calculated if an estimate of oceanic sediments can be made.⁶ Uniformitarian scientists have recently updated and increased an earlier estimate of global ocean sediments by 30%.⁷ They discovered a volume of $\sim 3.37 \times 10^8 \text{ km}^3$ with an average depth of 927 m. They broke this volume up into three areas: (1) the continental margins, (2) the deep ocean more than 200 km from the continental-ocean boundary, and (3) the area in between the two (table 1). Figure 1 shows the distribution of the ocean sediments. Notice that the thickest sediments are along the continental margins.

Erosion during the Recessional Stage

How much of this ocean sediment represents Recessional Stage erosion? In this overview, I assumed no sediments in the present-day oceans were deposited during the Inundatory Stage during the first 150 days. These continental margin sediments appear to be syntectonic, deposited during margin rifting. The rifts are parallel to the coast and caused by stretching of

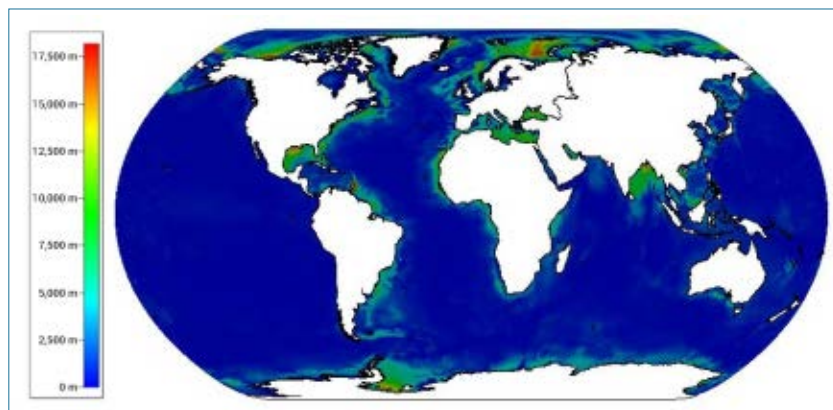


Figure 1. Depth to basement of marine sediments which is a surrogate for the sediment thickness (figure plotted from data in Straume *et al.*⁷)

the crust when the continents uplifted and the ocean basins sank during the Recessional Stage. Some of the deep-ocean sediments could be from the Inundatory Stage, but this volume is quite small (table 1) and so was ignored, especially since Recessional Stage and post-Flood sedimentation would have been substantial in the deep ocean.

Post-Flood continental erosion

To determine how much of the ocean sediments occurred after the Flood, I examined the various sources. The amount of erosion on the continents and deposition in the ocean by post-Flood catastrophes was neglected because the Flood/post-Flood boundary is in the Late Cenozoic, based on 33 criteria.⁸ So, the post-Flood oceanic deposition would be by present processes. Continents supply sediment to the oceans primarily through river drainage networks with roughly 33% coming from coastal erosion, and roughly 10–20% coming from wind and ice deposition.⁹ Roth estimated that the current average continental erosion rate was 61 mm/ka.¹⁰ Applying strict actualism, the average depth eroded from the continents in 4,500 years is only 0.275 m. This input is very small, and it would not matter if the continental erosion rate was an order of magnitude greater during the Ice Age. Thus, all the sediment from the margin, including the area between the margin and the deep sea, would be from Flood runoff.

The oceanic microorganism source

I then estimated the amount of deep-ocean sediments deposited during the Flood and post-Flood. The largest source of these sediments comes from microorganism skeletons. At the present rate, deposition for 4,500 years would be miniscule. However, microorganism deposition would have been much greater during the Flood and the post-Flood Ice Age, because

of massive vertical overturning of the oceans. Deep-water nutrients would often upwell and result in huge microorganism blooms. Thus, a fair percentage of the 404 m average deep sediments would be post-Flood.

We cannot use the uniformitarian dates of microorganisms, primarily calculated by biostratigraphy. Secular scientists sometimes claim ice-rafted debris in deep-sea cores as old as the early Cenozoic.¹¹ If this debris were truly ice rafted, some early Cenozoic bottom sediments would be post-Flood. More investigation is required. At this point, I conservatively assume that half of the 404-m average deep-sea sediment is from the Flood and half from post-Flood. Then 202 m of the deep-ocean sediments would be from Flood runoff.

About 1,900 m average Flood runoff erosion from the continents

Adding together all the ocean sediments from the continental margins and the area between the margins and the deep oceans and half the deep-ocean sediments, I arrived at a Flood runoff volume of $2.8 \times 10^8 \text{ km}^3$. The area of erosion is the area of the continents at $1.49 \times 10^8 \text{ km}^2$, while the area of deposition is the area of the oceans at $3.63 \times 10^8 \text{ km}^2$. The eroded volume divided by the area of the continents, amounts to an average depth of continental sediments eroded during the Recessive Stage of about 1,900 m (figure 2).

Some current estimates of continental erosion

I have estimated continental erosion at several locations on the earth and have obtained depths of the above order of magnitude. Based on the continental margin sediments east of the central Appalachians and coal rank, I estimated about 6,000 m of erosion from that area.¹² From the margin sediments, I estimated the average erosion over Namibia at 2,400 m.¹³

Almost 1,600 m of sedimentary rock has been removed from southeast England.¹⁴

The amount of erosion of the San Rafael Swell, with the top layer being the Green River Formation, ranged from 4,200–5,100 m.¹⁵ This figure is close to 2,500–5,000 m average erosion over the entire Colorado Plateau.¹⁶ Since the Colorado Plateau represents an area of about 337,000 km², the amount of erosion for the Colorado Plateau is 842,000 to 1,700,000 km³. The sediments have been swept off the continent, indicating a rapid watery mechanism consistent with the Recessive Stage of the Flood during the Cenozoic.

Estimates of erosion from the literature also indicate incredible continental erosion. For instance, for other areas of North America, more than 1,600 m of rock has been eroded from southern Arizona.¹⁷ More than 2,000 m of strata has disappeared from the Rocky Mountains and foothills of southern Canada.¹⁸

Similar erosion has occurred on other continents, especially mountainous areas.^{19,20} For example, 6,000 m of rock probably was removed from the

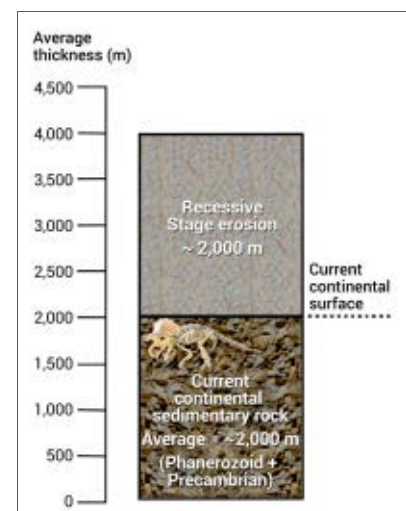


Figure 2. A block diagram representing the sediments and sedimentary rocks at Day 150 made up of about 50% remaining continental sediments and 50% that has been eroded during the Recessive Stage.

Flinders Ranges in South Australia.^{21,22} 3,000 m of rock has been eroded from the Welch Mountains of the United Kingdom.²³ Partridge believes that around 1,000–3,000 m of rock has been removed from southern Africa since the Cretaceous period according to the uniformitarian timescale.²⁴ 8,000–11,000 m of sedimentary rocks are believed to have been removed from above the Vredefort impact crater, South Africa, while 5,000 m was erased from above the Sudbury impact crater in southern Ontario.²⁵

How much sedimentary rock left on the continents?

Various estimates of the volume and average thickness of sedimentary rock left on the continents have been made, ranging from 1,800 m, by Blatt²⁶ to as much as 5,000 m, by Ronov.²⁷ These estimates vary because of an earlier lack of data, some of the continental margin sediments have been included as continental sediments, and various amounts of Precambrian sediment have been included. From research being conducted on North America by Reed (personal communication), it is so far estimated that about 2,000 m average sedimentary rocks are left on the continent. If we assume this average depth for all the continents (figure 2), about 3,900 m of sediment collected only on the continents and not in the oceans during the Inundatory Stage of the Flood.

Some implications of ocean sediments

The estimated amount of Recessional Stage erosion has numerous, surprising implications for the Flood. The erosion of 1,900 m of sediment is an indication of the tremendously catastrophic nature of the Recessional Stage of the Flood. The sediments left behind are expected to be mostly consolidated, since unconsolidated

sediments would have eroded more easily off the continents. Also, we creation scientists would expect surface features of the continents to reflect such massive runoff and not slow processes over millions of years. And indeed, geomorphology reveals these abundant features.^{2,3}

About 3,900 m of sedimentary rock and sediment accumulated on the continents with very little in the present ocean basins by the peak of the Flood. Then an average of about 1,900 m eroded off during the Recessional Stage. These events have tremendous implications for the Flood. Where did this sediment originate early in the Flood? How was it transported before deposition? How was so much eroded during the Recessional Stage?

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Humans and octopuses use the same mechanism to induce variation in the brain: LINE retrotransposition

Peer Terborg

Octopuses are among the most intelligent animals. Like humans, they have advanced cognitive and problem-solving skills that are of great interest to neurobiologists. No wonder research is increasingly focused on studying the brain and learning from these smart and inquisitive animals. Earlier, neurobiologists uncovered that the transposable element known as LINE1 is active in brain cells.¹ There, its activity is thought to be crucial to learning and cognition, because they accumulate in the presence of genes related to these processes. Now, scientists find members of the LINE (long interspersed nuclear element) family in the neurons of octopuses and also link them to learning and cognition. An incredible case of convergent evolution.

Tree thinking: convergence negates homology

Tree thinking refers to an approach to evolution education that emphasizes reading and interpreting phylogenetic trees.² It heavily relies on homologies, i.e. on similar characteristics, body parts and designs found in distinct organisms. In all textbooks on evolution, fins, paws, hands, and wings are presented as typical examples of homologies, which are then construed as the results of common ancestry. Tree

thinking, also known as phylogenetic inference, has always been a hallmark of evolutionary theory. It was expected, therefore, that shared traits should also have shared genetic background. Contrary to this expectation, it is now increasingly found that homologies in morphological blueprints are often not caused by homologous genes. Evolutionary biologist Günther P. Wagner demonstrated that homologous traits often involve separate parallel developments underlying different genetic principles.³ Thus, the same traits are supposed to have arisen multiple times, independently of each other. In other words, tree thinking based on homology may be severely flawed. It can then only be explained as convergence (or convergent evolution), a term that conveys the message that the same or very similar traits can arise independently of each other.

The concept of ‘convergence’ has received much interest, and references to it within academia are increasing, because it poses severe difficulties for tree thinking: convergence and homology are mutually exclusive. Convergence negates homology. Both terms are nothing more than interpretations of the inference of time suggested by the trees’ branches when there is an inability to trace the assumed origins of evolution. It should be noted that evolutionary relationships of all forms of life within ‘trees of descent’ are limited to their similarities only; differences between organisms do not fit such trees and in practicality refute common ancestry. Likewise, convergences brought about by different genetics refute common ancestry. Wagner finds this “a pretty depressing situation” because it shows that “homology can be an illusion”.³

Variation-inducing genetic elements (VIGEs)

A major part of the genomes of organisms is made up of what scientists now call *transposable and transposed elements* (TEs). These are

DNA sequences that migrate from one place in the genome to another, leaving behind copies of themselves. That is why they are also known as *jumping genes*. The most complex TEs are *endogenous retroviruses* (ERVs) and LINEs. Approximately 8% of the human genome is composed of ERVs and 17% of LINEs. Both ERVs and LINEs have long been regarded as junk DNA; selfish, functionless virus-like evolutionary relicts. A growing number of investigations define these elements as important structural and regulatory elements of the genome, and they are increasingly appreciated as a major driving force of evolution.⁴ Since LINEs appear to be particularly good at generating novel genetic contexts, which is nothing else but variation, I coined the term *variation-inducing genetic elements* (VIGEs).^{5–8} That this name was aptly chosen is now also clear from recent brain research showing that transposable elements widely contribute to features associated to the complexity of the nervous system. In particular, somatic retrotransposition of LINE-1 in cells of the hippocampus has been linked to human cognition and learning.^{9,10} Studies in *Drosophila* have also demonstrated that learning and memory are related to the activity of transposable elements in brain cells, and that their activity is finely regulated.^{11,12}

Convergence?

To assess whether a similar mechanism operates in the brain of octopuses, a group of Italian scientists used next-generation sequencing technology to analyze the molecular composition of the genes active in the nervous system of the common octopus (*Octopus vulgaris*) and the Californian octopus (*Octopus bimaculoides*).¹³ In this way, they were able to identify all functional TEs, including LINEs, and determined their exact location in the DNA. They found that the activity of one of the LINEs resulted in specific signals in neurons belonging to areas associated

with behavioural plasticity, the counterpart of the hippocampus in humans. The researchers concluded that “a convergent evolutionary process involving retrotransposons activity in the brain has been important for the evolution of sophisticated cognitive abilities in this genus.”¹³

According to conventional science, the two bilaterian *Metazoa* (animals), humans and octopuses, can hardly be further apart in the phylogenetic framework: octopuses belong to the phylum Mollusca, humans to that of the chordates (figure 1). The two phyla are believed to be separated by 500 million years of random evolutionary processing. Nevertheless, humans and octopuses have very similar eyes—so-called camera eyes—allegedly the result of convergent evolution, an illusionary idea that two (or more) organisms can evolve the same biological structures independently. Now, an even more remarkable convergence has to be assumed with respect to how both organisms achieved sophisticated cognitive abilities through the independent acquisition of LINE retrotransposons.

The observation that humans and octopuses use the exact same mechanisms to induce variation in brain neurons through retrotransposition of LINE requires explanation. How did two distinct phyla, vertebrates and mollusks, manage to come up with the same learning mechanism? The researchers, Dr Petrosino and Dr Stefano Gustincich, commented as follows:

“This similarity between man and octopus that shows the activity of a LINE element in the seat of cognitive abilities could be explained as a fascinating example of convergent evolution, a phenomenon for which, in two genetically distant species, the same molecular process develops independently, in response to similar needs.”¹⁴

Every time two (or more) distinct organisms display the same or very similar traits, which cannot be the result of descent, convergent

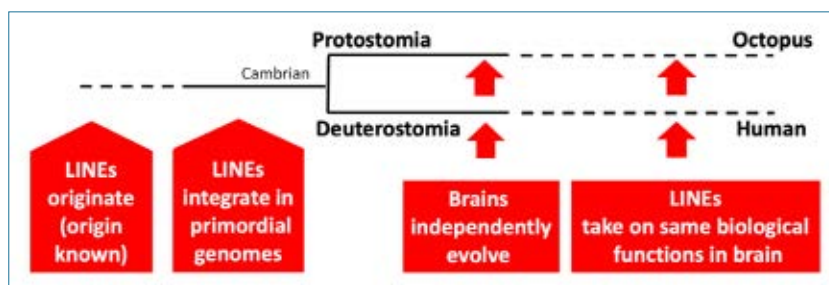


Figure 1. Evolutionary conception of convergent evolution to ‘explain’ how LINEs came about to control learning processes in the brains of both octopuses and humans. After an unexplained origin, LINEs invaded primordial genomes before the Cambrian, and before brains had evolved. Then, LINEs independently coopted the same functions in rewiring genetic circuitry involved in learning processes.

evolution must be invoked. It should be noted that convergent evolution is not an explanation, rather it is a term for an unexplained observation that presupposes evolution. Did the authors study evolution? No, they studied learning processes in octopuses and find—completely unexpectedly—that it involves the same mechanism as already known in humans.

Across the Metazoa, there are many different neural structures that are considered to exhibit functional brain-like activity (e.g. anterior ganglia, neuro-pile). Many of them contain neuronal cell types, and neurite connectives found in vertebrates are also present in echinoderms (Ectodermata). Nevertheless, the brains as present in humans and octopuses did not exist at the basis of the Metazoan tree, as we can still observe in today’s echinoderms (see figure 1). So, how can evolutionary genetic convergence occur in species whose common ancestor did not even possess the corresponding organ in which it is active? A similar question can be asked for the LINE elements. They must have been present before the split of mollusks and vertebrates, indicating that LINEs must have existed even before the Cambrian explosion. Ever since, they were selfishly free-riding the genomes leaving copies and debris everywhere. Later, LINEs were independently co-opted to fulfil essential biological functions in the

brains of octopuses and humans. It also remains elusive how these elements were maintained and conserved for hundreds of millions of years if they were merely viral invasions. Convergence involving independent co-option of LINEs stretches evolutionary credulity beyond reason.

LINEs are not remnants of viruses

The evolutionary explanation for the multitude of ERVs and LINEs present in genomes is that they are supposed to be the remnants of retroviruses which invaded the genomes millions of years ago. Some modern retroviruses, such as the human immunodeficiency virus (HIV), indeed resemble ERVs. Rather than ERV being integrated leftovers of (HIV-like) retroviruses, however, retroviruses (including HIV) are better explained as transformed ERVs that escaped from the genome.^{6,7} In the creation science framework, ERVs are functional genetic elements involved in genome organization, rewiring of the (epi)genomic regulatory circuits, ordered intercellular trafficking, and the facilitation of variation.⁶⁻⁸

That LINEs are supposed to be remnants of retroviruses is not supported by empirical science, i.e. unlike ERVs there are no retroviruses resembling LINEs. LINE1, which is a transposable element active in the human genome,

is a complex genetic element with two open reading frames, ORF1 and ORF2. The protein coded by ORF2 provides essential enzymatic activities for the reverse transcription, as well as for integration of a newly transposed copy of LINE1. Thus, LINE1 propagates through a copy-paste mechanism, thereby leaving identical copies on different positions in the genome. The exact role of ORF1 is unclear. It specifies a protein with protein-binding properties, but it can also function as a nucleic acid chaperone.¹⁵ The actual origin of LINE1 is completely unknown, however. The only reason to perceive LINES as the remnants of retroviruses is that they possess a reverse transcriptase gene faintly resembling that of ERVs. It should be emphasized, however, that LINES have a unique genetic make-up, which makes them unique genetic elements not related to retroviruses. The Italian brain researchers now provide further evidence that LINES operate in genomes as VIGEs. That they originated in a distant past as viruses is merely belief, not science.

Argument against common descent

For almost a century, the field of evolutionary biology has been dominated by the neo-Darwinian research program. The primary hypothesis of this program holds that all species have originated through natural processes by descent with modification from only one common ancestor. On the other hand, the creation science framework postulates independent origins ('creation') of baramins with built-in flexible genomes (coined 'baranomes') to vary, adapt, and speciate.¹⁶ From the start, baranomes contained a limited number of VIGEs—including ERVs and LINES. In distinct baranomes, VIGEs may have been located on the exact same position in the DNA (the T-zero position), which then explains why some VIGEs can be found in the

same location in genomes of modern organisms independent of the assumption of common descent, for instance in great apes and humans.

Functionality of LINES is very important to discern between the neo-Darwinian and the creation science framework. *If* LINES were without function, and *if* they integrated randomly in genomes, common ancestry of the neo-Darwinian framework would be strongly supported.¹⁷ If, on the other hand, LINES were functional and if their genomic integration was strongly regulated and controlled, the argument for common ancestry would be weak. The presence of the same VIGEs on the same location in the genomes of distinct species would then boil down to merely an argument of 'nested hierarchy', i.e. groups within groups within groups. These groups are based on suites of similar traits, and it is a different way of presenting evolutionary 'tree thinking'.

That we find LINES with the exact same function in both vertebrates and mollusks is a strong argument that shared retrotransposons, even if they are present in the exact same location in the DNA, do not necessarily imply common ancestry. Rather, their functional presence argues for a front-loaded modular design system to induce controlled and regulated variation.^{6–8} Such mechanisms, which are increasingly identified in the genomes of organisms, witness to the greatness of the Creator, who foreknew of the Fall of man and of the worldwide Flood. In His immeasurable goodness, He designed his creatures in such way that they could rapidly adapt to entirely novel environments and fill every corner and crevice of the earth.

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Equivocal carbon dating of ancient footprints in Tularosa Basin, New Mexico

Andrew Sibley

Scientists have discovered human footprints in the Tularosa Basin of New Mexico, USA; more specifically in the White Sands National Park. Recently assigned radiometric dates of these footprints conflict with the previous understanding of human occupation of North America based on genetic reconstruction studies.

Tularosa Basin is enclosed by mountains, so no water can flow out of it. Instead, water evaporates, thus forming several dried-out lakes, known as playa lakes, such as Lake Lucero (formerly ancient Lake Otero) (figure 1). The ancient lakebed is known for its selenite or gypsum crystals ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). In this environment multiple tracks of human footprints have been preserved (figure 2) alongside evidence of large mammal habitation (also primarily from footprints) such as mammoths

and giant sloths, and predators such as lions and wolves. When the footprints were made the environment at this site was evidently much wetter and better suited for human occupation.

Ice Age footprints

These footprints have recently been conventionally dated to 23–21 ka before present (BP), which the researchers believe correlates with the period of the Ice Age in North America (the Late Pleistocene). The dates have been determined by the stratigraphy, together with carbon dating of co-located seeds from freshwater plants. The plant in question, *Ruppia cirrhosa*, more commonly known as spiral ditchgrass or spiral tasselweed, grows today in fresh or brackish shallow water, with its foliage sourcing carbon from the water, not the air (figure 3). The researchers discounted hard water or reservoir effects¹ as having any significance on their findings, partly because of the shallow nature of the water in which the plants grew, which would have led to the likely exchange of atmospheric carbon into the water over time. The presence of so many footprints suggests it was a more hospitable place (i.e. wetter) for

mammalian life to thrive than the current desert environment allows. Uranium/thorium dating ($^{230}\text{Th}/\text{U}$) of gypsum from boundary strata gave ‘ages’ of between 100 and 25 ka, but the authors narrowed this down through the selection of representative data to 25.6 ± 4.4 ka.²

As a result of this ancient time-frame, the scientists proposed that humans had colonized North America from Asia during the Last Glacial Maximum, which is earlier than the standard narrative allows. The official narrative is that human settlers had not arrived in this part of North America before 20 ka. This estimate has been determined through studies of ancient DNA from human fossils, together with assumed rates of genetic change. If the footprints are older, it would invalidate such genetic reconstructions.³

Disagreement over carbon dating

However, other researchers were far less certain and called into question the outcome of the carbon dating. They argued that the ground water in the lake would not have reached (near) equilibrium with atmospheric carbon dioxide, and therefore would lead to false readings. In attempting

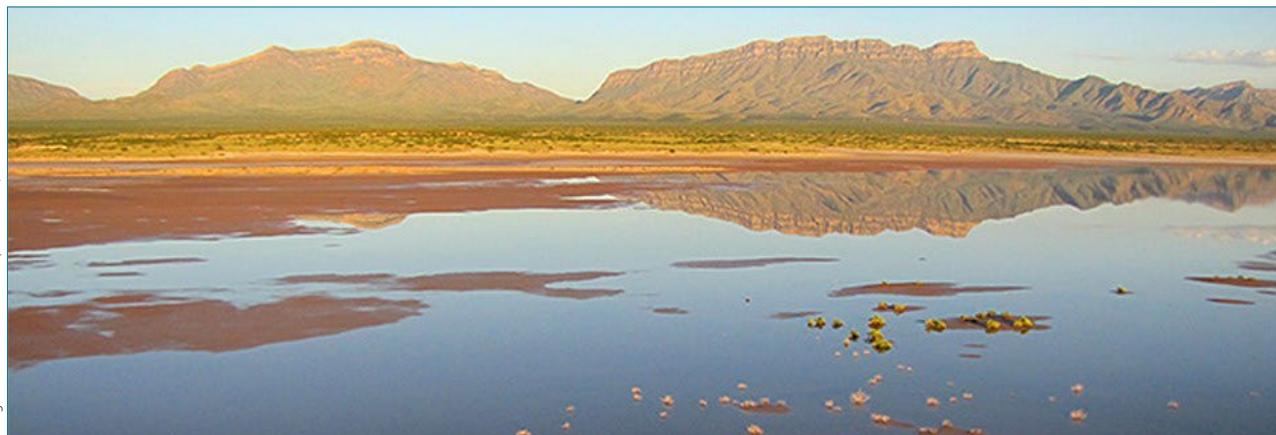


Figure 1. Lake Lucero, New Mexico

Image: National Park Service, Wikimedia / Public Domain

to re-evaluate the age of the footprints, these scientists carbon-dated more recent seeds of the same spiral ditchgrass that were collected at Malpais Spring in 1947. They found that the seeds contained very low levels of carbon-14, proposing that the carbon in the seeds had not been sourced from the air, rather from the ground water, which contained very little carbon-14.

Measurements of carbon-14 of this specimen were recorded at about 7.4 ka, and yet the seeds were only 75 years old, an error of two orders of magnitude. If applied to the previous samples, it would revise the dating of human footprints downwards, from 23–21 ka to a more ‘acceptable’ 15–13 ka, which is in accord with the standard model of when humans are believed to have arrived in North America.⁴ The researchers have called for further studies, including carbon-dating of biological material from atmospheric sources, and optically stimulated luminescence dating of the lake sediment quartz.³

What does this tell us about the accuracy of dating?

This example shows that radiometric dating can give very different results, and the selection of dating

preferences is driven by the needs of the secular narrative. In other words, it is another example of the need to fit the data to protect the official model. While carbon dating can be fairly accurate for dating trees, where the carbon has been taken from the atmosphere, much larger errors arise when water is involved; for example, with the marine reservoir effect and the hard water effect.⁵ There is clearly uncertainty with the example of Lake Lucero—the fact that seeds which are only 75 years old can be dated to 7,400 years BP due to hard water effects demonstrates the margin of error. This effect has previously been known to give excessive ages; for example, pottery fragments used to cook fish have been mistakenly ascribed ages 2,000 years older than they really are.⁶

While the later researchers (Oviatt *et al.*⁴) seek to hold to the standard model of human migration, their work highlights just how uncertain dating methods can be, and it is a serious challenge to the wider secular narrative. Creation scientists would interpret the human footprint data as that of the post-Babel dispersion of people from the Middle East during the later stages of the Ice Age, with a time-frame of around 4,000 years before present.

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Figure 2. White Sands National Park has a large collection of fossilized human footprints.



Figure 3. *Ruppia cirrhosa*

Fossilized animal and bird footprints in megasequences

I appreciate the time and effort that Froede, Akridge and Reed took in composing their article, “Fossilized animal and birds footprints in megasequences.”¹ This letter is in response to their request for better resolution.

First of all, I admit we could have drawn the Day 40 and Day 150 lines on our figure more accurately in our *CRSQ* paper (figure 1).² Day 40 should properly align with the end of the Kaskaskia megasequence and the onset of the Absaroka megasequence. This places the boundary between the Mississippian System (lower Carboniferous) and the overlying Pennsylvanian System (upper Carboniferous) on the traditional stratigraphic column. Also, Day 150 probably should have been placed at the top of the Zuni megasequence (base of the Tejas megasequence), which extends slightly into the lowest layers of the Paleocene of the so-called Tertiary System.

Also, I admit that we do not have a perfect understanding of the fossil footprints and their causes in the Tertiary. And yes, there shouldn't be any live land animals to make footprints after Day 150 of the Flood year until the post-Flood epoch.

That said, figure 2 in the Froede *et al.* paper shows fossil footprints extending upwards from the Zuni megasequence all the way to the top of the Tertiary, with only the dinosaur prints stopping at the end of the Cretaceous. Furthermore, the diagram seems to suggest there are the same number of fossil footprints throughout the entire Tertiary (Tejas). However, this is not really the full story.

According to Brand and Florence,⁴ who did a fairly comprehensive study

of animal tracks throughout the rock record, the majority of Tertiary (or Tejas) footprints do not appear until late in the Tertiary. They also show that it is not just the dinosaur footprints that disappear at the end of the Cretaceous, but all trackways from reptiles and animals designated as ‘other reptiles’ and even a group called ‘indeterminate animals’ also disappear at the same level (end Zuni). This implies there must be something significant about the end of the Cretaceous (near the end of the Zuni) in terms of the Flood year. In addition, they found that tracks for amphibians disappear in the rock record at in the Permian, about midway through the Absaroka megasequence.

We interpret the many types of land animal tracks that simultaneously end in the Cretaceous or earlier as evidence of a progressive Flood that peaked (Day 150) at the end of the Zuni megasequence.² As each ecological zone was inundated by the rising water, those animals and plants living at each zone was systematically entombed in the rocks, including any footprint records.

In addition, much of the global geology indicates the high-water point (Day 150) was reached at the end of the Zuni megasequence also. For example, the Zuni covers the most surface area of any of the six megasequences.² We initially found this to be true across

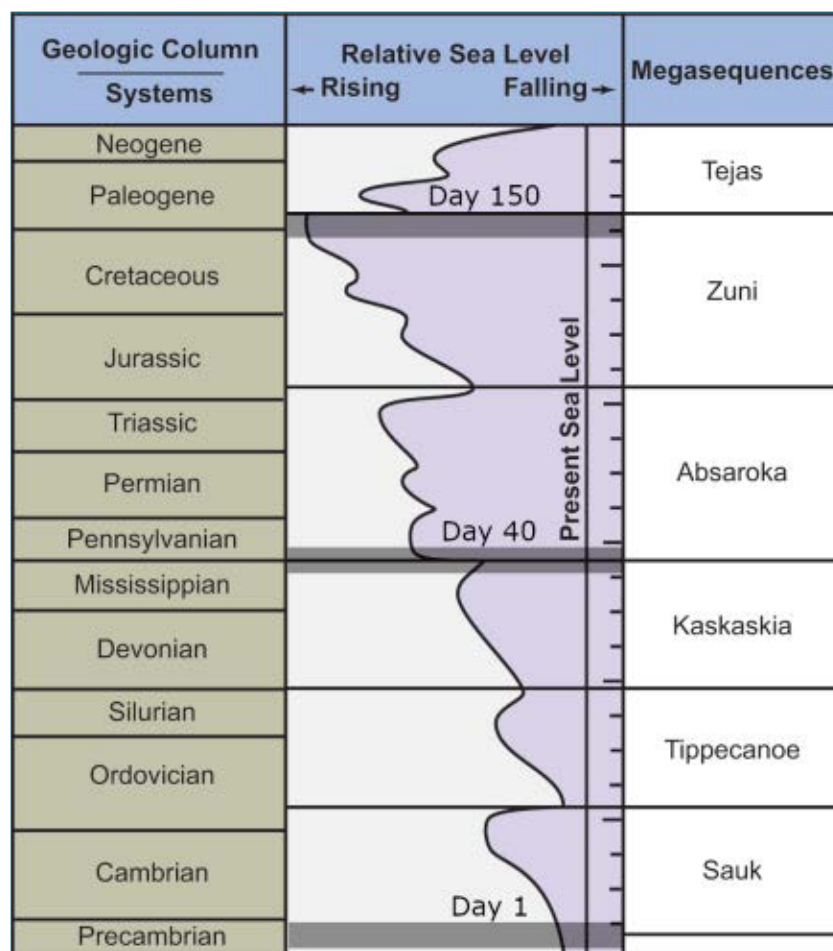


Figure 1. A revised version of figure 2 from Johnson and Clarey.² Diagrammatic global sea level curve showing the megasequences and geologic systems with Days 1, 40, and 150 superimposed.³ Day 1 is the initiation of the Flood in the pre-Sauk (late Precambrian). Day 40 is near the boundary of the Kaskaskia-Absaroka when the Ark became free-floating. Day 150 is interpreted as the sea level peak near the end of the Cretaceous System and near the end of the Zuni Megasequence.

three continents and our unpublished research has found this to be true across five continents to date (except Australia and Antarctica which are in progress). Also, the Zuni has the second highest sedimentary volume of any of the six megasequences across five continents. It is second only to the Tejas, which we interpret as much of the receding phase (post Day 150). It should be no surprise that the post-Day 150 sediments have the most volume as it was the material that was scraped off the rising mountains and the exposed land surface as the water drained.

And there is a large amount of geological data suggesting sudden changes in water direction occurred at the end of the Zuni too, including deposition of the 300–600 m thick Whopper Sand in the deep Gulf of Mexico.^{5,6} This sand body extends across much of the Gulf and was deposited at the very onset of the Tejas megasequence.⁷ It most likely formed from massive sheet-like drainage off the North American continent as the water began to recede. Again, indicating the Tejas is mostly receding phase.

Finally, there are tremendously extensive deposits of coal offshore Asia and Australia buried within Tejas sediments, indicating massive amounts of plant material was washed off the land into the ocean at that point in the Flood.⁸ All of this geological evidence indicates the Flood peaked at about the end of the Cretaceous.

I will admit the tracks in the mostly upper Tejas megasequence rocks are yet unresolved. But we cannot throw out the global stratigraphic record in the process. It's the whole 'baby and the bathtub' analogy. There is just too much stratigraphic and fossil data that indicate the Tejas is post Day 150.

Maybe Mike Oard is correct and conventional paleontologists have misinterpreted the upper parts of the Tertiary (Tejas). Maybe some upper

Tertiary layers should be Pleistocene instead. Each site needs further study. Furthermore, megasequences should not be labeled 'naturalistic'. They are real, mappable rock strata that can be properly correlated from continent to continent across the globe. And they can be used to defend the biblical account as recorded in Genesis. But, yes, many details still need to be worked out. I thank you for reminding me of these issues.

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» **Carl Froede, Jerry Akridge, and John Reed reply:**

We appreciate Tim Clarey's willingness to discuss his ideas regarding megasequence boundaries, the problem of fossil animal tracks and trackways, and their implications for the Flood. We stand with him in believing that the Flood was responsible for the bulk of Earth's strata and that any Bible-supporting model must conform to the Genesis account.

We appreciate his clarification of the stratigraphic megasequences formed during the Flood. In that light, we are curious where the referenced 'post-Flood-epoch' stratigraphic boundary is on his new figure. Since he agrees with our initial assertion that no tracks or trackways formed by living animals should be found following Day 150 through the end of the Flood, such a boundary seems necessary to a stratigraphic understanding of Flood-formed megasequences, and how Tertiary/Quaternary trackways fit.

This is an important issue and Clarey's appeal to Brand and Florence appears to ignore work of the past 40 years in identifying and cataloging tracks throughout the Tertiary and Quaternary.^{1,2} Our logic is simple: if no tracks could be made between the end of Day 150 and the end of the Flood, then strata with tracks formed by living animals must be dated either: (1) prior to or on Day 150, or (2) after the Flood. From the Genesis text, it is obvious that tracks and trackways created by living animals are crucial diluvial stratigraphic criteria.

Another key biblical stratigraphic indicator is found in Genesis 7:19–20, which unambiguously states that Earth was 'planet ocean' at the height of the Flood. However, a perusal of naturalistic-based paleogeographic maps and sea-level curves spanning the late Cretaceous and early Paleogene^{3–6} conveys dry land as well as epeiric seas. Based on this information, was there ever a point near the Mesozoic-Cenozoic boundary (Zuni-Tejas megasequence contact) where Earth was unambiguously and completely submerged? If not, we should question the secular sea-level curves, paleogeography, and sequence/megasequence boundaries.

That illustrates our primary point of departure from Clarey. We stand with him in many ways and applaud his hard work to find a better stratigraphic understanding of the Flood. But we remain skeptical about how to filter the work of uniformitarians to decipher the Flood. This discussion reaches back several decades; present readers may

be unaware of the problem. Two biblical timescales have been proposed,^{7,8} and both diverge from uniformitarian geology in understanding footprints, tracks, and trackways of formerly living animals.^{9–11}

Perhaps the best way for readers to grasp our fundamental difference with Clarey (and others supporting the use of megasequences in Flood stratigraphy) is through two of his statements: (1) his ‘baby and bathwater’ analogy, and (2) his aversion to our label of ‘naturalistic’. We have many articles published showing the links between secular geologic history and the worldview of naturalism,^{12–25} particularly in its support for the uniformitarian philosophy of history. We believe this unfortunate and unnecessary link has influenced geologists since the late 18th century in the way they define strata. Most young-earth creationists claim that the naturalistic geologic timescale is compatible, requiring only minor adjustments via megasequences (or accelerated nuclear decay or time compression²⁶). In II Corinthians 6:14, Paul asks: “What fellowship has light with darkness?” and we believe this has a wider application than marriage. We heed theologian Robert L. Dabney (1820–1898), who stated in answer to Lyell and Darwin:

“I repeat, if any part of the Bible must wait to have its real meaning imposed upon it by another, and a human science, that part is at least meaningless and worthless to our souls. It must expound itself independently; making other sciences ancillary, and not dominant over it.”²⁷

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Image: WR Barnhart

Figure 1. Grand Caverns vent hole in the middle of a great domed ceiling

What is the origin of clastic pipes?

I commend Michael Oard for tackling another difficult topic in Clastic Pipes. I know how easy it is to take pot shots at other authors, so instead, let me add a few issues that Oard seems to have missed. He has written on karst formation, so I was surprised he missed the connection to caves and breccia pipes in the Redwall. Wheatley *et al.*¹ recognize the connection between clastic and breccia pipes because they state that they form a continuum from containing isolated random pieces of breccia in matrix to pipes completely filled with breccia skarn. The amount of breccia would be a good gauge to determine the lithification encountered by the ascending gas column.

Figure 1 is my image from Grand Canyon Caverns; the vent hole shows a distinct spiralling up to the right. It is one of two showing the same characteristic in this cavern (each in separate domed rooms). The same spiral can be seen in Groaning Cave, Colorado, and Cave of the Dome, Grand Canyon, Arizona. These four locations are the very minimum. Oard's figure 1 of Chimney Rock Clastic Dike shows a similar spiral movement in the breccia/clastic fill. Drawings of Breccia Pipes show a similar restoration, especially of uranium deposits, so it can be safely assumed the spiral is recognized in the uranium skarn from those mined pipes.

Oard cites the Wheatley *et al.* paper, but he fails to note that the trend they provide would lead into the multitude of Breccia Pipes (figure 2) I cited in the Grand Canyon area in my previous piece on that subject.² The arc Wheatley *et al.* shows directly ties into the Sevier Fault Zone extending across Utah and including the Sevier Thrust Zone in western Wyoming.

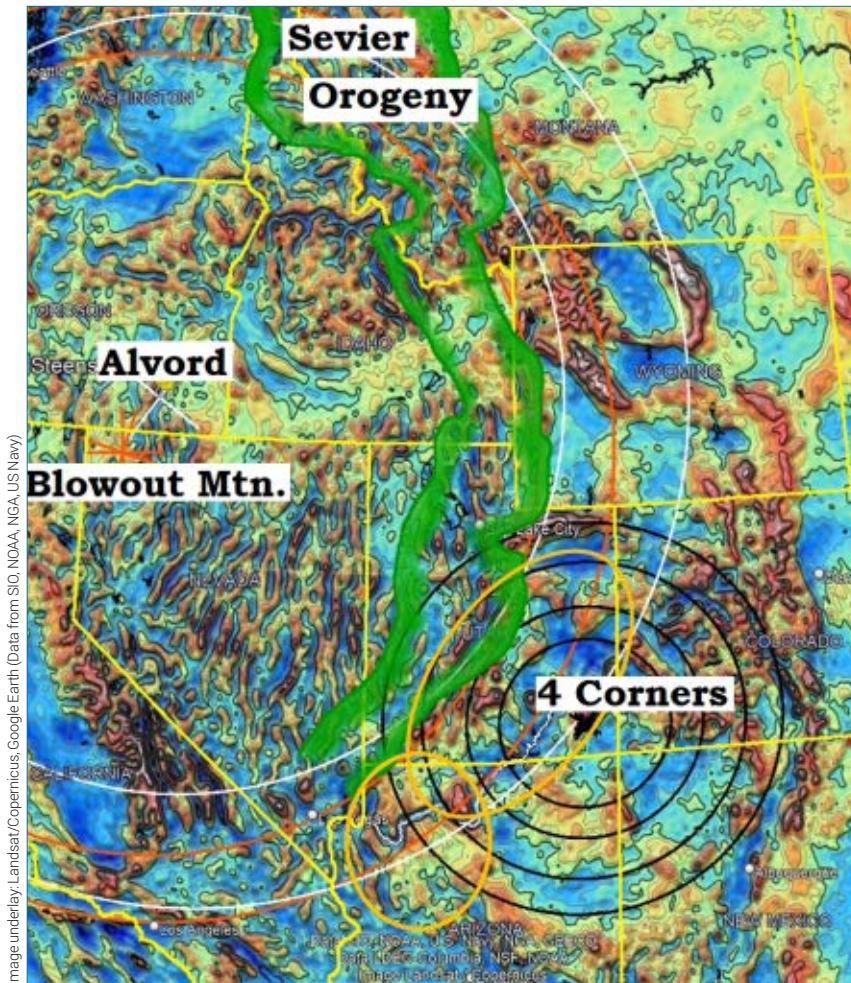


Image underlay: Landsat/Copernicus, Google Earth (Data from SIO, NOAA, NGA, US Navy)

Figure 2. Global Gravity Anomaly (Scripps³) overlay to Google Earth showing area of most pronounced up-thrust of the Sevier Orogeny in green. The circular lineament from Alvord in white, and circular lineaments from the Blowout Mountain centre in red. Four Corner circular Lineaments in black. Upper oval in orange indicates locations of clastic pipes from Wheatley *et al.*,¹ and lower oval indicates locations of breccia pipes from Barnhart.²

From my own work on the Sevier Thrust Zone, the arc relates to the later Blowout Mountain shear point (Euler Pole) rather than the more slightly eastern Alvord shear point (Euler Pole). Therefore, it is related to the later (Blowout Mountain/Cretaceous) thrust rather than the earlier (Alvord/Precambrian) thrust. This would connect the occurrence to this later event rather than to the earlier and settle the quibbling about timing. Much of the research on the Sevier Orogeny is confused because researchers fail to distinguish these as two totally separate events. The occurrence of two events this major seems to contradict some creationist leaning towards a single monstrous event of the Flood (one land rising, one major draining of the continents.). Since both of these thrusts minimally extend from British Columbia, Canada to Arizona, USA, both of these represent major land movement upwards (land rising).

The additional location of overlap from the Four Corner circular lineaments suggests a more than accidental connection to clastic and breccia pipe locations, and may be the source of the penetration's dating.

While top-on views of Clastic Pipes are lacking, the Google View of the Orphan mine (figure 3) at Mariposa Point on the south rim of the Grand Canyon shows a distinct pipe-in-pipe structure. This is definitive for gas escape structures rather than water escape structures. Wheatley *et al.* prefer a hydrologic origin rather than gas because they find that visually bisected pipes show a flaring at their tops and bottoms. They fail to separate flaring produced by dropping of the surrounding strata, as seen in views of Eagle Point Breccia Pipe, and concentric-fracturing-produced flaring outside of the pipe. Hot gas rises not due to pushing but by melting their way upwards through considerable heat.

This explains their pipe-in-pipe structure, allowing the pieces to fall around the bubble of hot gas.

As I determined,² not only would clastic and breccia pipes require the strata to remain partially mobile, but they would also need to be very hot for mantle gases to escape this far upward, almost a mile of sediment around the Grand Canyon, and retain enough heat and pressure to move upwards successfully. As in my previous paper, I dealt with elevated temperature in the Tapeats Sandstone through to the Moenkopi Formation, clastic pipes in the Navajo Sandstone require elevated heat up into these layers. This suggests the sand erg had a very hot origin and did not include moving water at standard temperatures less than several hundreds of degrees. I would suggest the Navajo Sandstone was laid in the typhoon winds returning into the centre of a cratering event, hot enough that quartz was condensing from a

vapour cloud. These are extreme aeolian conditions in the middle of very hot water. Temperatures far hotter than any desert will produce.

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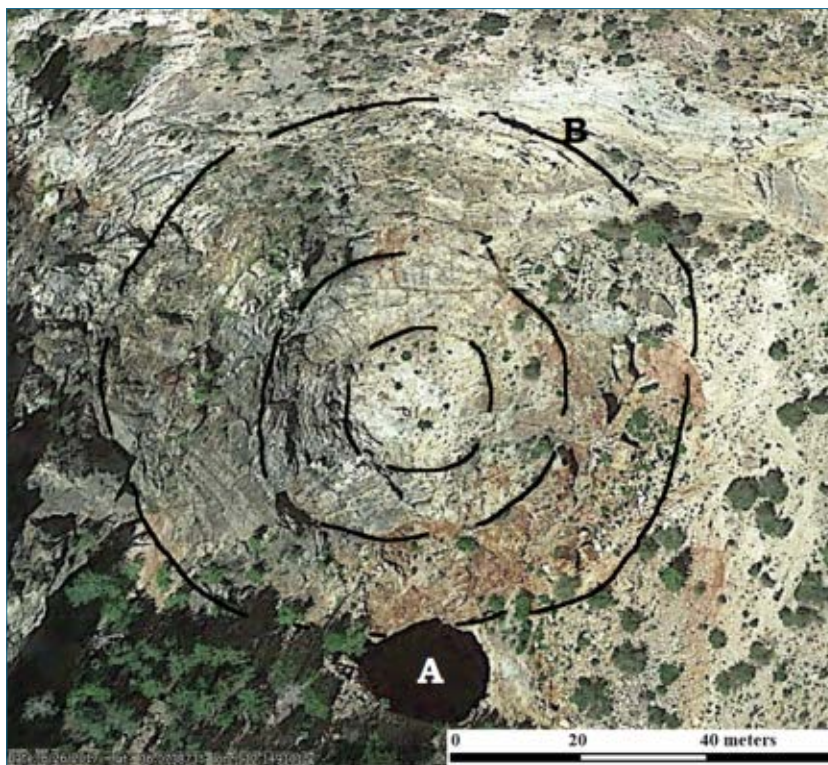


Figure 3. Google Earth view of Orphan Copper-Uranium Mine on South Rim of Grand Canyon

Design, evolution, and awkward silence

Foresight: How the chemistry of life reveals planning and purpose

Marcos Eberlin

Discovery Institute, Seattle, WA 2019

Bruce Lawrence

Foresight, by Dr Marcos Eberlin, is about the design of life, the fine-tuning of the universe, and the inadequacy of naturalistic storytelling. It discusses the origin of life, the limits of natural selection, and the naturalistic bias that permeates the scientific community. It includes many examples of fascinating designs in living things and explanations for why evolution cannot reasonably be invoked to explain these features.

Marcos Eberlin has a Ph.D. in chemistry from the University of Campinas. He boasts an impressive career with many accomplishments. He founded the Thomson Mass Spectrometry Lab, was the president of the International Mass Spectrometry Foundation, and won the Thomson medal in 2016. Eberlin stands as a great example of a highly qualified scientist who does not believe in evolution and believes that the universe was created by a supernatural designer. This allows the book to stand out among Intelligent Design (ID) books, as it argues for the existence of a supernatural creator, and against the General Theory of Evolution.

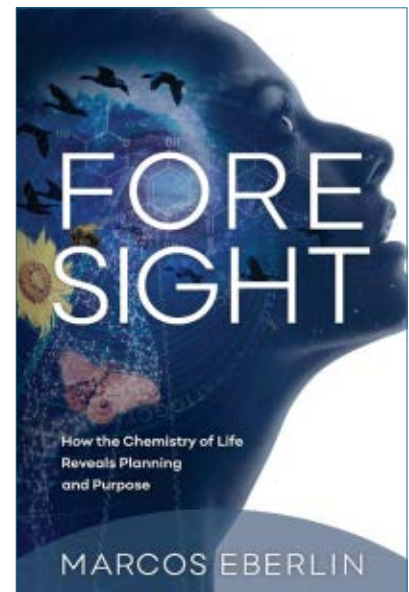
The book is rather short but packed full of information. It contains nine chapters with roughly half the book focusing on the intricacies of life at the cellular and molecular level. These chapters focus on biochemistry, organelles, proteins, and DNA. The

second half of the book focuses on multicellular organisms such as insects, carnivorous plants, birds, humans, and special features found in specific multicellular organisms and features shared among many multicellular organisms. The first half of the book is fairly technical. Unless you are already familiar with organic chemistry and cell biology, there is a good chance that you will need to consult a textbook or utilize an internet search engine.

Intelligent Design movement

Within the ID movement, there is a strange variety of individual beliefs, and objectives. The common theme is that they argue against naturalism in favour of some unspecified designer, and argue against unguided evolution. However, many design advocates will accept guided evolution. The ID movement refuses to associate itself with biblical creation and instead argues for a generic designer. The question of ‘who’ or ‘what’ this creator may be, is typically avoided. The motivation for this seems to be an attempt to cast the widest net and garner as much support as possible. This is also an attempt to seem non-religious and more scientific.¹

Unfortunately for the ID movement, this approach fools almost no one. The anticreationists in secular institutions are aware of the philosophical implications of acknowledging design in the universe. This author stands out with his book because he makes multiple statements explicitly endorsing the existence of a supernatural, transcendent creator that crafted the entire universe, but he does not identify this designer with the God of the Bible. If this becomes a trend, then we may



see the movement as a whole come to acknowledge who the designer is.

Venus flytrap

While there are many excellent examples of design throughout the book, there are those that stand out among the crowd. One of the most memorable examples is that of the Venus flytrap on pp. 95–98. These plants use specialized leaves that function like a mousetrap. The leaves have special sensory hair-like structures that respond to physical contact. When at least two hairs are touched, an electrical signal is released that causes the leaf to quickly close, thanks to its precise geometric shape.² After closing, the trap progressively tightens to ensure the victim remains in place. Once properly shut, the plant begins secreting a liquid mixture of specialized enzymes that dissolve the prey and allow its proteins to be absorbed.

On page 95 the author claims that without these enzymes already being in place, there would be no purpose for the trap. He further points out that over the past 150 years, no serious attempts have been made to explain how “these amazing creatures could have evolved their intricate and highly synchronized

anatomical, electrical, and biochemical functions”. The evolutionary explanation for carnivorous plants is, as Eberlin describes:

“... the ‘Why-with-no-how’ evolutionary fallacy. It’s easy to explain the advantage (‘why’) of a feature, but the ‘how’, with the corresponding mechanisms and detailed evolutionary pathway at the molecular level, is largely or wholly ignored. Such ‘explanations’ fail to consider the immense risk and difficulties of such an evolutionary leap” (p. 77).

This fallacy, defined elsewhere in the book, can be applied to the carnivorous plants here. The author also provides an attack on the ‘why’:

“If carnivory evolved here to provide more nutrients, why would natural selection reward the plants—apparently able to benefit from more nutrients—for expending some of the precious nutrients they already had to evolve a not-yet-useful new nutrient supply tool, and reward these supposedly evolving plants for their seemingly far-sighted efforts over countless generations stretching over long ages? That is, if the nutrition from the carnivorous action was just a non-essential bonus for the flower, then why would nature select for all the intermediate steps of this complex bonus system during which the system offered no benefit—neither nutrition nor protection—and likely exacted a

nutrient cost at the risk of survival?” (p. 96).

“If it first evolved for protection, and then later evolved to provide additional nutrients, we have the same problem: Why expend all the energy on the way to a functional protection system, before the protection system was at all functional?” (p. 97).

Evolution has no foresight

This communicates the core argument of the book. Foresight is something not present in differential reproduction. The only things selected are physiological changes that provide an immediate and substantial increase in reproductive success. A mutation that notably increases root length could help with gathering essential nutrients from poor soil; a mutation that causes defective leaf development can produce thorns.³ Both relatively simple changes provide clear costs and benefits without the need for a developing structure to be almost useless over millions of years.

This shows an issue with the ‘why’ in evolutionary storytelling. It is often easy to see how a certain feature is advantageous, and thus why it would evolve. However, this exercise in imaginative storytelling breaks down when you ask, “why would natural selection favour defective structures that would be a detriment to the species for generations?”

Mantis shrimp

The second design argument that I believe deserves special mention is the peacock mantis shrimp (figure 1). This crustacean uses modified appendages that function like a club. The most common use for the appendage is to break clam shells so that the shrimp can eat the animal housed within. The punches exerted by the mantis shrimp are some of the fastest recorded with a top speed of 80 km/h (50 mph) in less than 800 microseconds. The force generated is 2,500 times the shrimp’s body weight. The punches produce small flashes of light, and the lowering of the water pressure causes the water to boil.

The punches rely on a spring mechanism and create a force like a crossbow. The mantis shrimp, when kept in captivity, needs to be housed in specially reinforced tanks, as the shrimp often wields its explosive punches and breaks a normal glass tank. The book goes on to explain how this shrimp can strike with such explosive force without injuring itself. The impact region of the club is covered in a hard but brittle mineral called hydroxyapatite. But this material is backed up by layers of chitin fibres dispersed in mineral. The composition forms a durable composite material that prevents cracks propagating. The material structure is just one of the features in place that allow the shrimp to strike so hard without injuring itself.⁴ The author quotes some evolutionary storytelling provided by *National Geographic*. The *National Geographic* writer Ed Yong states:

“Some scientists think that the Mantis Shrimp’s belligerent nature evolved because the rock crevices they inhabit are fiercely contested. This competition has also made these animals smarter than the average shrimp. They are the only invertebrates that can recognize other individuals of their species and can remember the outcome of a fight against a rival for up to a month” (p. 94).

Image: National Science Foundation / Public Domain



Figure 1. A female peacock mantis shrimp (*Odontodactylus scyllarus*). The impact region of its punching club is made of a durable composite material that protects it from injury.

Eberlin swats back, explaining: “It’s a nice story but fails to explain how the tiny shrimp developed all this technology and know-how by unguided trial and error, one small functional mutation at a time. All the pieces of the punching mechanism had to be in place for it to work ...” (p. 94).

Other high points

Eberlin takes the time to explain the difference between historical sciences such as evolution and experimental sciences. He explains:

“Contrary to popular perception, science is a diverse human activity and there are many different scientific methods ... For instance, laboratory science or bench science, focusing on how things work now, employs one methodology. But the historical sciences, including origins science, draw on the methods of bench science but also on others, since origins science seeks to discover the cause of events in the past, events therefore not observable in the way one could, for instance, observe things in molecular biology using advanced microscopes” (p. 42).

The distinction Eberlin makes is one that biblical creationists strongly emphasize and that informed evolutionists will acknowledge when not trying to convince people of evolution. While those in the ID movement do not endorse the creationist position, it is good that he draws this distinction. Many people who shy away from biblical creation often do so because they do not understand the fundamental difference between the two forms of science. As a result, they are intimidated into compromising. If this understanding of evolution becomes widespread outside the biblical creationist community, then perhaps proponents of other positions will see that the ages assigned to fossils, interpretations of rock layers, and even big bang theory also fall into this camp of historical science.

Failings

The book falls victim to the typical weaknesses of the ID movement. The issue that stands out the most is the example of carnivorous plants. While it is an effective argument in favour of design, and against naturalistic storytelling, it raises the question of who the designer is. One must wonder, if this designer made plants that trap small animals, and subjects them to death by acid bath, then is this designer a cruel and sadistic entity, or is this agent simply uncaring? While the issue itself does not challenge the question of ‘if’ there is a designer, it certainly raises questions about the moral character of this supernatural entity that forged all life and the universe. While the book does not ignore the issue entirely, the author throws the burden onto unnamed theologians. This shows a common weakness of the ID movement. When examining attack and defence structures in nature, the author is unable to explain carnivory, death, and disease through the Fall. As a result, the unspecified designer of life appears to be malevolent.⁵

The other issue is the weakness seen in how the author seeks to provide an alternative definition of science. The alternative definition of ‘science’ is “A systematic and unbiased search for truth about nature.” He emphasizes that science requires freedom of thought, speech, and data collection. He then states:

“If science—the search for absolute truths hidden within nature—is to be unflinchingly truth-directed endeavor, reason and evidence must be the only constraints” (p. 44).

Yet, this ignores the philosophical presuppositions of science.⁶ This fails to understand that all conclusions are tentative in science, and evidence is always interpreted according to pre-existing bias. Certain ideas (e.g. that we can understand the universe) must be accepted as true from the start for science to be reasonable at all.⁷ While the philosophical bias

of the researcher is less influential in experimental science, it is very prominent in historical sciences.⁸ The author effectively communicates the distinction between these forms of science, but he neglects to explain the extreme and inescapable effect that bias has on historical sciences, e.g. an unbiased search is not a possibility. While his point about the unreasonable prejudice against intelligent design in the scientific community is very well made, his alternative proposal is less than ideal.

A good ID book, but still an ID book

The book contains many solid arguments in favour of intelligent design and does a great job of exposing the unscientific nature of evolutionary biology. While it does rise above the standard ID offering by identifying the designer as a supernatural, transcendent creator, he provides a flawed distinction between historical and operational science. The book still contains the typical shortcoming of books on ID. By ignoring the identity of the Creator, this book will have a limited impact in spreading the Gospel.

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Evolutionary flights of fancy

Flights of Fancy: Defying gravity by design & evolution

Richard Dawkins, illustrated by
Jana Lenzová

Head of Zeus Ltd, 2021

Philip B. Bell

Retired University of Oxford professor Richard Dawkins' colourfully illustrated book *The Magic of Reality* (2011) was intended to persuade younger readers that evolution was 'really true'.¹ His most recent book, *Flights of Fancy*, is in the same vein, although not explicitly aimed at children. Dawkins is a very good writer, and the beautiful illustrations by talented Slovakian artist Jana Lenzová make for an enjoyable reading experience. Needless to say, however, this is another propaganda piece for evolution, although those arguments do not really begin in earnest until chapters 12–13 of this 14-chapter work.

Along the way, the author surveys the marvellous diversity of flight exhibited by various living organisms, as well as human dreams of flight down the centuries of time—everything from the legendary Icarus, Leonardo da Vinci's depictions of winged angels, hot air balloons, parachutes, gliders, and the succession of powered flying machines. There are lessons in aerodynamics, the significance of size in relation to various types of flight, and even musings about the urge to fly away from our planet and to visit other worlds. Much of the book is commendable, but I will restrict this review to the origins-related matters covered in the latter chapters.

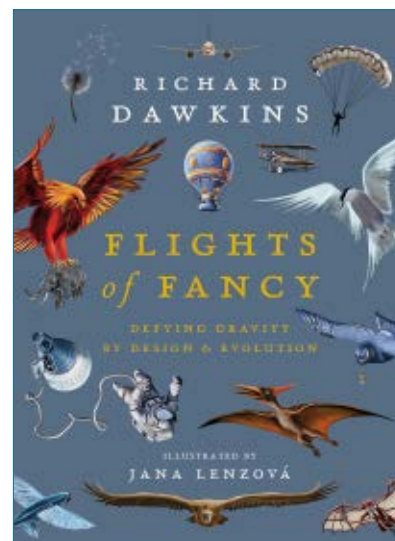
Fanciful forays about flight

Richard Dawkins seemingly intended the title of his book to be a double-entendre: *flights of fancy* includes both the imagination and ingenuity of humans in devising flying machines and the supposed power of evolution to generate the wonderful diversity of flying animals. One can hope that it might dawn on a proportion of his readers that many of the author's evolutionary stories are also little more than flights of fancy. Three examples follow.

Evolution of gliding?

Dawkins admits to preferring "the 'trees-down' theory" of flight evolution to "the 'ground up' running theory", when it comes to the evolution of gliding mammals (pp. 258, 260). He admits, however, that both theories may be invoked, depending on the particular type of vertebrate that one is imagining taking to the skies. For example, most advocates of dino-to-bird evolution prefer the 'ground up' (cursorial) theory for developing flapping bird flight. In fact, both models are flawed. It is hard to take the 'trees-down' idea seriously, even when buoyed along by a skilful writer like Dawkins, as in the following example:

"Any squirrel might have a little loose skin in its armpits. That loose skin will slightly increase the squirrel's surface area without adding much to its weight. This skin flap will work like a bushy tail but more effectively to slightly increase the distance the squirrel can leap without falling. ... Whatever gap a particular squirrel can jump, the canopy will present some slightly longer gaps which another squirrel can jump because it has a slightly larger area of skin flap. And so we have the beginnings of another smooth gradient of improvement.



Which is all we need for our evolutionary argument" (p. 255).

Seriously? How is this qualitatively different from 'How the camel got his hump' and other *Just So Stories* by Rudyard Kipling? The author's descriptions of the supposed origin of mammalian *flapping* flight similarly fails to rise to higher levels of sophistication. Perhaps appeals to the paleontological evidence might help?

"As it happens, there are no useful fossils to tell us how bats first launched themselves into the air, but it's *easy to imagine* a plausible gradient" [emphasis added]" (p. 256).

Easy it might be, but imagination does not qualify as science.

Dawkins makes a similar appeal to "a gradient of improvement" (p. 266) from observations of chicks of the Australian brush turkey (megapodes).² The hatchlings are incredibly precocious: fully-feathered, and able to run and fly on the day of hatching! They flap their wings to help in running up almost vertical tree trunks, so the author asks readers to imagine brush turkey ancestors climbing progressively steeper slopes (over deep time), less well-developed wings evolving into better ones. The problem is that imagined evolutionary gradients are no substitute for scientific evidence.

Evolution of wings?

Theories of wing evolution are many and various. Regarding insects, some argue that wings evolved from modified gills. Others imagine that aquatic nymphs scooted along the water using ‘sails’ (the precursors of wings), or else that they developed stubby structures that stuck out as ‘solar panels’ to help them warm up—these stubs later evolving into proper wings. In the latter scenario:

“As the wings became larger, they found themselves automatically becoming more useful as flight surfaces. These later evolved into proper wings” (p. 268).

Mr Kipling strikes again! But these evolutionary flights of fancy are unsurprising considering the striking paucity of evidence for insect wing evolution. Erica McAlister is Senior Curator of the Diptera (and Siphonaptera) at London’s Natural History Museum. Here is the sum total of what she had to say on the subject of insect wing evolution in her superb book *The Inside Out of Flies*:

“How wings evolved, and from what structures, has still not been resolved, due to very limited fossil evidence to help us understand what evolutionary process occurred. It is thought wings evolved only once in insects, and that was some time around 370–330 million years ago during the Upper Devonian or Lower Carboniferous ... ”³

Undeterred, Dawkins also considers the evolution of flying mammals a cinch:

“Far from being difficult, for the ancestors of bats, the task of evolving a patagium and then wings would have been easy: just a matter of *refraining* from apoptosis, accompanied by lengthening the finger bones relative to the arm bones [emphasis in original]” (p. 258).

Apoptosis is a program of cell death (deletion) which is involved in the selective removal of tissue between the digits of the developing mammalian limb bud. But these things

are not simple at all and no amount of hand waving can prevent his idea from crashing to the ground. For one thing, production of a suitable bat patagium (forewing membrane) results from a highly complex interplay of pro- and anti-apoptotic protein signals in the developing infant bat, a veritable molecular choreography. Too much apoptosis (unconstrained) would result in no patagium forming (producing an earth-bound bat). Too little apoptosis would mean that thick, heavy webbing would remain in the interdigital areas, a massive encumbrance for the poor creature, prohibiting flight. As I have demonstrated elsewhere, biologists know that it is categorically *not* a simple “matter of *refraining* from apoptosis”.⁴

Evolution of feathers?

A discussion of flight in birds would be incomplete without accounting for the origin of feathers. Unfortunately, here too, readers are served outdated tall stories rather than scientific argument:

“Feathers are modified reptile scales. They probably originally evolved not for flight but for heat insulation like mammalian hair. Once again we see evolution taking advantage of what’s already there. ... It has only recently been discovered that, before true birds evolved, feathers were common among the group of dinosaurs from which birds sprang. It even seems likely that the dreaded *Tyrannosaurus* had feathers” (p. 99).

Such claims, albeit made by certain leading tyrannosaur experts, are simply wishful thinking.⁵ On the contrary, fossil skin impressions of large theropod dinosaurs reveal their integument to have had a great variety of scales, but no trace of feathers; imaginative theorising notwithstanding.⁶ Chapters 17 and 18 of Sarfati and Tay’s recently published *Titans of the Earth* provide an up-to-date assessment of alleged dino-bird evolution theories and the various fossil candidates.⁷ The alleged ‘discovery’ that many



Image: Doug Beckers, Wikimedia / CC-BY-SA-2.0

Figure 1. Brush turkey youngsters are fully feathered, able to run and fly on the day of hatching!

dinosaurian ancestors of birds were feathered is merely an assertion, and Dawkins fails to acknowledge that this point is hotly disputed by some avian experts, though themselves evolutionists. Surprisingly, he does not even mention claims of featherlike structures in pterosaurs, published nearly three years before his own book.⁸

R&D vs thoughtless evolution

The author compares and contrasts millions of years of slow-and-gradual evolution of flying animals with decades-long human research and development (R&D) of flying machines. He opines that people are mistaken when they conclude that the similar end results imply a similar method:

“With animals, the [R&D] process ... takes many generations spread over millions of years. No thought goes into it, no clever ideas, no deliberate ingenuity, no creative inventiveness. All that happens is that some individuals in the population just happen, by random genetic luck (mutation and sexual shuffling of genes), to be a little bit better than average at, say, flying” (p. 236).

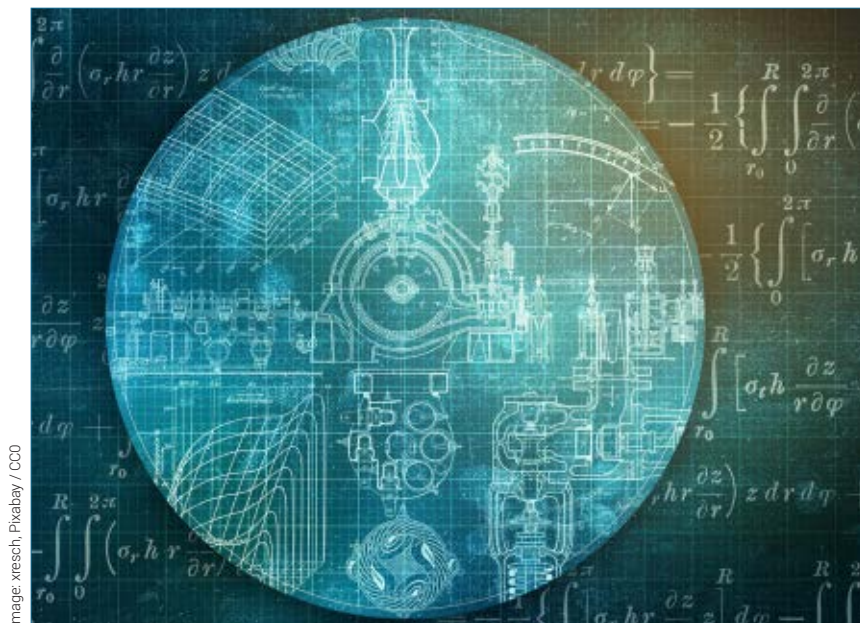


Figure 2. Was animal flight evolution like an R&D process, spread over millions of years—except mindless and unintelligent?

And lest his readers have failed to grasp the point he is trying to make, he adds:

“Slowly, slowly, gradually, gradually, generation by generation, the good-at-flying genes become more numerous in the population. The bad-at-flying genes become less numerous, as animals that possess them are a little bit more likely to die or fail to reproduce. ... So, after lots of generations, after millions of years of accumulating good flying genes in the population, what do we see? We see a population of very good flyers ... *just as if* a human engineer had perfected the design on a drawing board and tested it in a wind tunnel [emphasis added]” (p. 237).

But no, the artificer was really a ‘blind watchmaker’. Dawkins assures readers that the good animal flying structures seen today represent the culmination of a mindless trajectory. They are, he says shamelessly, “the end products of ... evolutionary design”, an oxymoron if there ever was one! Human designers seeking to design a new flying machine can start afresh, but Neo-Darwinism cannot go back to

a blank drawing board. “Evolution is opportunistic: it tends to modify what is already there rather than sprout something completely new” (p. 94). It is not envisaged as growing wings on an organism from scratch, but incrementally modifies existing limbs into wings. Limited this may be, but that is because: “Evolution is condemned to modify previous designs step by tiny step. And every step along the way has to survive at least long enough to reproduce” (p. 242).

Notice the word ‘design’ again—it seems he cannot help himself.

Those rather silly creationists!

Anyone familiar with Richard Dawkins’ writings will half expect a little dig, here and there, at those who believe that the ‘design’ he keeps talking about points to a designing Creator. It is not long in coming:

“There are still some people who don’t believe in evolution, in spite of the overwhelming evidence in its favour. They want to believe that bird and bat wings, like plane wings, are produced by deliberate creative design: design

by some kind of supernatural master engineer. They’re called creationists. You won’t find them in proper universities. But there are plenty of them in less educated circles” (p. 251).

A tired, hackneyed claim to be sure. Apparently, the author is convinced that the cooked-up yarns he has served up to his readers really *are* ‘overwhelming evidence’ for the evolution of flight in living organisms. Dawkins is well aware that his put-down of creationists is quite untrue but his deceit is in the service of evolutionary propaganda. Numerous credentialed creationists have studied and/or still teach at ‘proper universities’.⁹

Moreover, at the risk of sounding churlish, educated evolutionists in the universities have some very fanciful ideas themselves. Indeed, the author himself, in the final chapter of his aptly named *Flights of Fancy*, contemplates flying to, and colonizing, other planets. For what purpose? To perpetuate the human species should a pending massive extraterrestrial impact spell doom for our home planet:

“But whatever the threat to Earth, whether it’s a comet or an unstoppable plague, there’s something to be said for ... founding a colony of humans on another planet such as Mars. Of course, Mars might also be struck by a giant asteroid. But both planets would not be struck by the same one—or by some plague—and you’ve surely heard the proverb about putting all your eggs in one basket” (pp. 276–277).

Silliness can be found in all sorts of places!

Final thoughts

This review has focused upon the sections of *Flights of Fancy* with which biblical creationists and design theorists would take issue. Most of the first 230 pages are good reading, marred by the final 50 pages of fancy masquerading as science. A notable exception to this is Dawkins’ belittling of the value and dignity of human life:

“Disagreeable as the thought might be to starry-eyed idealists not used to thinking like economists, human life is not infinitely precious. We put monetary value on it” (p. 68).

Au contraire! And this brings us to the heart of why *Flights of Fancy* is ultimately a big let-down. It fails to credit the Designer God for the fascinating array of flight designs in diverse fauna, and it even attacks the one creature made in His image. And, in truth, it is a well-presented package of lies, wrapped in pleasant prose and pictures.

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Evolution’s last pillars are tottering

The Last Pillars of Darwinian Evolution Falsified: Further evidence proving Darwinian evolution wrong

Jerry Bergman

Westbow Press, IN, 2022

John Woodmorappe

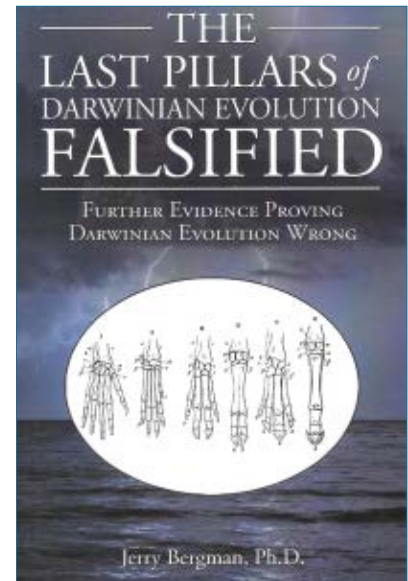
Jerry Bergman is a famous creationist author who has extensively published over many decades and who has taught at several universities. He describes the research that went into this book:

“This project has been for me a lifelong study for which this book is a summary. It is the culmination of four decades of research on the issue of evolution, 41 years of teaching life science at the college level, and over 1,700 publications in 2,400 college libraries in 65 nations and 13 languages” (p. xvii).

In terms of specifics, this work focuses on taxonomy, so-called convergent evolution, irreducible complexity, pseudogenes, and antibiotic resistance. Bergman goes into considerable detail on all of these.

What is a species, and what does it matter?

Author Bergman discusses the many subjectivities of taxonomic classification. How much variation should there be in a group before deciding if it is one species or more than one species? If reproductive isolation is the criterion for recognizing a species, does this reproductive isolation have to be absolute, or is it



sufficient if it is usual? If infertile hybrids form between two species bred in captivity, do we still recognize two species, or should there only be one? And that deals with captive animals. How can we practically determine reproductive isolation (or lack thereof) in most cases in nature? How can we determine if any reproductive isolation we determine is genetic in nature, or if it is mechanical or from some other factor? So much for macroscopic life. How do we define species in bacteria when bacteria can swap genes? Finally, how do we recognize species among fossils?

Speciation, by itself, is not the same thing as evolution. Bergman quips:

“Although necessary and useful, the species concept has clear limits that disallow its use to document macroevolution. Changes within a species that are sufficiently large to prevent interbreeding do not provide evidence for macroevolution. Even the much-touted ring species cases are rare and problematic.

Neo-Darwinism requires evidences of changes much greater than simply the prevention of interbreeding between two very similar life-forms” (p. 23).

Homology and convergence: evolutionists want to have it both ways

In conventional evolutionary thinking, the more similar two organisms are to each other, the more recent their common ancestor. However, two organisms can be similar to each other even though they are not closely related. That is what convergence is all about. Structures are homologous if they are believed to have arisen from a common ancestor that had that structure. By contrast, evolutionists invoke convergence on an *ad hoc* basis whenever there are unexpected similarities between life-forms that are otherwise thought to be distantly related.

Evolutionists try to explain convergence in terms of life-forms evolving under similar selection processes that derived from being situated in similar environments, coupled with the presumed fact that there is only a finite number of ways a biological structure can evolve into existence. This could theoretically explain convergent features that are superficially similar to each other, such as the bird wing and the insect wing. It is quite another thing to invoke convergence for very similar outcomes.

Consider placentals and marsupials. They are each entirely separate lineages of mammals that are very distant from each other on the mammalian evolutionary ‘tree’. Yet the placental wolf (*Canis*) and the Tasmanian wolf (*Thylacinus*) have extraordinary similarities between their respective skulls. Bergman comments:

“A Tasmanian wolf (thylacine) skull, when examined carefully

and compared side by side, can be seen to be distinctly different from a North American wolf skull, even though many of their major skull traits and their overall shape are almost identical” (p. 46).

Bergman adds:

“... the American wolf and the Tasmanian wolf mentioned above, are far too similar to have evolved separately from an ancient common ancestor during the early Cretaceous, as convergent evolution theory postulates Their skeletal structures, especially their skulls and teeth, are so similar that, unless compared side by side and labeled, only someone who has previously studied the difference can distinguish between them. The close similarity is used as part of a museum exhibit in Australia to illustrate the fact that there are fewer differences between the Tasmanian wolf and *Canis lupus* than between many dog breeds As part of their final exam, zoology students at Oxford were required to identify 100 zoological specimens. A ‘dog’ skull that actually was the Tasmanian Wolf *Thylacinus*, successfully fooled many students until they caught on to the ploy. The examiners then placed an actual dog skull in their laboratory exam, which again confused the students. Dawkins noted that the main ‘way to tell the difference is by the two prominent holes in the palate bone, which are characteristic of marsupials generally’” (pp. 49–50).

Let us take this further. Bergman quotes Harvard’s Stephen Jay Gould, who said human origins “is the product of massive historical contingency, and we would probably never arise again even if life’s tape could be replayed a thousand times” (p. 52).

So evolutionists are being internally inconsistent. On one hand, they say that it is astronomically unlikely that evolution could closely repeat itself.

Then evolutionists turn around, and, with reference to the extraordinary similarities between the skull of the marsupial wolf and the skull of the placental wolf, they say that evolution has in fact closely repeated itself. So which is it?

Co-option and exaptation do not overcome irreducible complexity

Co-option and exaptation refer to biological structures that supposedly evolved in a response to selective pressures for one function, and then were co-opted by evolutionary processes to have a different function. For instance, one theory of bird-wing origins is that wings evolved in order to make birds seem larger and more ferocious, and these were subsequently ‘recruited’ by later evolutionary processes for flight.

We hear that irreducible complexity is not real because the components of a complex system can each have alternative functions. This confuses the issue, which is not the function of a component itself, but how the function of the entire system could arise step by step. For instance, the spring in the mousetrap, acting alone, can be used in many different devices. Fair enough. However, the ‘springiness’ of the spring is not the essence of the mousetrap—it is the unique configuration of all the components of a mousetrap, including the spring, that enables it to function as a mousetrap. That is what needs to be explained by evolution.

Bergman touches on some of the challenges facing a putative evolutionary explanation, for the origins of complex structures, resulting from the co-option of components originally having different functions. He comments:

“... the availability of these parts would have to be synchronized ... the parts must be correctly and properly positioned in 3-D space so they can be properly assembled

Even if all of the parts are available at the proper time, the vast majority of assembly variations will be non-functional or dysfunctional” (pp. 145–146).

So the irreducible complexity remains.

Redundancies in living things do not vitiate irreducible complexity

Some evolutionists have vulgarized the Intelligent Design explanation as a ‘jackpot or nothing’ one. But that is exactly what it is, and evolutionists have failed to show how the emergence of a complex biological structure can be anything other than ‘jackpot or nothing’.

Evolutionists have argued that biological systems only appear to be irreducibly complex because these systems once had possessed numerous redundancies that enabled the components to function independent from each other. These redundancies have since been removed by evolutionary processes, leaving the remaining components in a state of lockstep dependence upon each other—hence the apparent irreducible complexity.

To begin with, the explanation is *ad hoc*. There is no evidence for any such one-time grand redundancies, and, if they are going to pooh-pooh the Intelligent Design explanation, the burden of proof is on the evolutionists to show that they once existed. Note also that spot redundancies should not be confused with the hypothesized grand redundancies that presumably governed the whole. In the Krebs cycle, for example, a few of the compounds can be synthesized by alternative pathways. The fact that parts of the Krebs cycle are redundant is very different from saying that the Krebs cycle *as a whole* is, or once was, redundant. The fact that there are ‘shortcuts’ within the Krebs cycle is very different from suggesting that

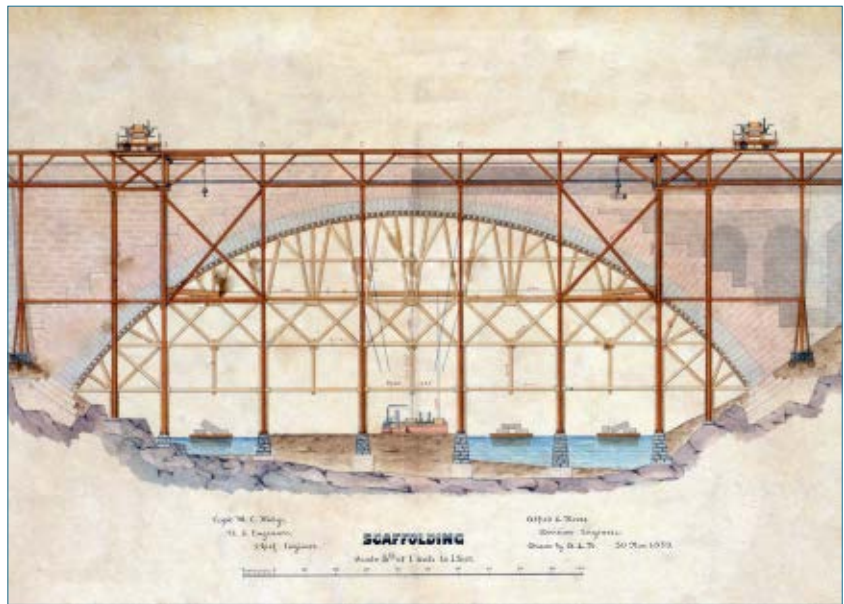


Image: U.S. Army Corps of Engineers, Wikimedia / Public Domain

Figure 1. The scaffold that supports the construction of a stone arch does not vitiate irreducible complexity. It is a tailor-made structure that is *itself* a manifestation of irreducible complexity!

the entire Krebs cycle can be bypassed by a shortcut. Bergman quips:

“Reducing the cycle by one step does not negate the fact that it still requires the remaining parts of the cycle. It would not be irreducibly complex only if a single quark were responsible for the biochemical results that the Krebs cycle achieves” (p. 123).

An analogy with the automobile may help. The car thief can do a ‘shortcut’ around the key-starting system by short-circuiting the wires that lead to the starter motor, and driving away the car. This means that, from a mechanical point of view, the key-starting system is redundant. However, this individual redundancy certainly does not mean that the automobile as a whole is a redundant system, much less that the automobile could spontaneously arise, step-by-step, without intelligent design.

‘Scaffolding’ does not overcome irreducible complexity

The stone arch is a classic example of irreducible complexity. It cannot be simplified. There can be no

step-by-step evolution of the arch, because there is no such thing as a quarter-arch or half-arch. It is a ‘jackpot or nothing’ situation: it is either a full arch or no arch at all. Some evolutionists have tried to get around this by pointing out the fact that the arch can be constructed, step by step, by using scaffolding. One stone in the arch is not dependent upon any other stone until such time that the scaffold is removed. Let us take a closer look at this contention.

The scaffold enables a Roman arch to be constructed, and holds the stones in place, relative to each other, until they are all in place. While the scaffold is in place, stones can be added or removed at will. Once the arch is constructed, and the scaffold removed, the stones in the arch are in complete dependence upon each other, and no stone can be removed without the arch collapsing. This is the irreducible complexity.

Note that the scaffold does not eliminate the irreducible complexity: it merely relocates the irreducible complexity from the arch to the scaffold! (figure 1). Any old collection of wooden pieces will not spontaneously

make an arch-constructing scaffold: it takes intelligent design to tailor-make a scaffold that is even minimally suitable for erecting a stone arch. In addition, a suitable scaffold cannot arise from a step-by-step processes. Just as there is no such thing as a quarter-arch or half-arch, neither is there such a thing as a quarter-effective scaffold or half-effective scaffold. Either we have a fully effective scaffold for constructing the arch or we have no scaffold at all. The ‘jackpot or nothing’ situation has not been overcome. It remains.

Pseudogenes: not relics of an evolutionary past

For a long time, evolutionists have triumphantly invoked pseudogenes. After all, surely no intelligent designer would litter our genome with disabled and non-functional genes. Not so fast. Bergman reviews the recent literature on this subject. It shows that some pseudogenes definitely have function. They are in no sense ‘disabled’. In fact, there is now no sharp boundary between genes and pseudogenes.

For a long time, genes were defined as genomic structures that enable a protein to be coded and synthesized. So, if a suspected gene cannot encode a protein, it must therefore be non-functional. Now we realize that this is not so. It turns out that a pseudogene that has obvious features that prevent it from coding a protein can, nevertheless, have a different function, such as a regulatory one that uses mRNA.

Bergman expands this consideration to cover all DNA in the genome which has long been dismissed as junk DNA just because it does not code for a protein and because, until recently, it had no known function. Now we realize that much so-called junk DNA is transcribed into RNA, which implies at least a possible function.

Bacterial resistance to antibiotics: not evolutionary novelties

Evolutionists often cite antibiotic resistance in bacteria as evidence for evolution. It is not. It is a product of the ‘tweaking’ of pre-existing features in the bacteria, which raises the question of how these features arose in the first place. Bergman comments:

“Bacteria can also become resistant as a result of mutations, but all of those mutations studied so far are either *loss* mutations, or gene *expression* mutations that result in speeding up the already existing systems that remove or inactivate antibiotics. None are the result of new cellular innovations but are caused merely by altering the volume control [emphasis in original]” (p. 193).

Bergman further clarifies this matter:

“What is commonly referred to as *gaining resistance* to an antibiotic is more accurately understood as a bacterial strain that has lost sensitivity to the antibiotic. Bacteria were resistant to many antibiotics long before humans used them. This has been confirmed by culturing bacteria found on human explorers frozen to death long before human-developed antibiotics existed [emphasis in original]” (p. 190).

For evolution to occur, there must be an increase in biological information. This is lacking. Bergman elaborates:

“The recent development of bacteria and insect resistance *does not* support classically defined neo-Darwinism, which postulates evolution due to the natural selection of mutations. Macroevolution requires information-building mechanisms that add new information to DNA. In virtually all cases, bacterial or insect resistance is a result of the damage to an existing system, or a transfer of genes. In the rare cases where a mutation is involved, development

of resistance involves only loss mutations ... This is confirmed by the fact that resistance is acquired very rapidly, in far too brief a period for evolutionary emergence of complex biochemical or physiological systems [emphasis in original]” (p. 204).

Conclusions

Bergman has examined and deconstructed a variety of ‘pillars’ of evolution. Each one of them contains major flaws. Neither taxonomy nor genetics, for example, compel belief in evolution. Evolutionists have caricatured, but not overcome, the fatal problem of irreducible complexity. The best explanation for living things, whether somebody likes it or not, remains an intelligent designer.

A useful compendium on science and faith

The Comprehensive Guide to Science and Faith: Exploring the ultimate questions about life and the cosmos

William A. Dembski, Casey Luskin, and Joseph M. Holden (Eds.)

Harvest House Publishers, Eugene, OR, 2021

Shaun Doyle

The Intelligent Design (ID) movement has, for several decades, championed *scientific* arguments for design. They have also often eschewed any direct commitment to theism or Christianity, though most of their adherents are Christian theists.

In *The Comprehensive Guide to Science and Faith: Exploring the ultimate questions about life and the cosmos*, Christian theist members of the ID movement move beyond their typical limited stance on the science of intelligent design and forge a more comprehensive view of science and faith. Edited by William Dembski, Casey Luskin, and Joseph Holden, it is a compendium of nearly 50 essays from over 30 different contributors that is split into four major sections. It addresses many different topics on science and faith—Christianity, design, evolution, and the age of the earth, but also transhumanism, panspermia, and the history of science.

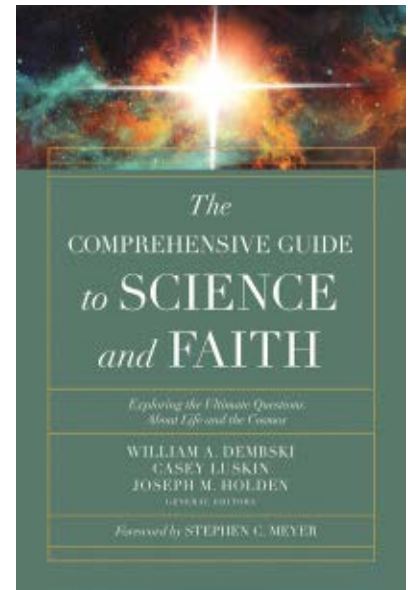
There is no way to do justice in a short review to a compendium this long. As such, I will focus on a broad overview and touch on the points most salient to biblical creation.

Science and faith

The first section tends to deal with the general relation between science and Christianity. It is generally locatable on Ian Barbour's famous fourfold categorization of relationships between science and religion: conflict, independence, dialogue, and integration. The perspective defended in this book is most recognizable as 'integration'. Indeed, Dr Brian Gordon, the proponent of 'integration' in the recent *Three Views on Christianity and Science*,¹ contributes two essays to this volume. Nonetheless, the Thomistic influence of several authors also introduces notes of 'dialogue' into this volume.

The essays of this section are uneven and often quite repetitive. Possibly the best and most original is Richard Weikart's entry "How Has Evil Been Done in the Name of Science?". It is a good summary of his published work on the subject, which has been positively reviewed in *Journal of Creation*.² Perhaps the weakest entry is one that tries to delineate C.S. Lewis's approach to scientism and, to some extent, ends up conflating scientism, materialism, and nihilism. While there is often a relationship between the three ideas, they are not the same.

The most relevant essay to biblical creation in this section is Fazale Rana's entry "What Is the Biblical and Scientific Case for a Historical Adam and Eve?" The introductory sections of the essay are pretty good. When he begins to address the *timeframe* for Adam, however, he argues for the standard Reasons to Believe 'model of human origins', which denies that all fossil species of *Homo* except *Homo sapiens* are 'image of God' humans, i.e. he still falsely regards Neanderthals as subhuman animals. He also now 'dates' Adam's first appearance to as much as "about 150,000 years ago (\pm 50,000



years)" (p. 106). The retreat of Adam further into the past (and away from reality) according to the 'RTB model' continues apace.^{3,4}

Science and design

The second section focuses more on the positive case for design and how science interfaces with that case. In general, the quality of these essays is better than those in the first section. This is largely due to several of the contributors being veteran commentators on the issues they tackle. Stephen Meyer's opening entry to this section, "What Is the Evidence for Intelligent Design and What Are Its Theological Implications?", acts as a good summary of the entire section, and provides a potent abductive argument for design with theistic implications, as one might expect from his extensive work on the subject.

Some will find elements of this section objectionable. For instance, there are arguments for 'free will', and the author of those essays, Michael Egnor, takes a Thomistic approach to free will. Elements of Hugh Ross's entry on fine-tuning presuppose an old earth and cosmos, and so they either don't really work or can be recast as matters of design parameterization during Creation Week.

The most relevant chapter to biblical creation is William Dembski's essay "Why Does Intelligent Design Matter?" Here he stakes out a unique spot for intelligent design in the context of the origins controversy, and notes what he thinks are several advantages. In contrast to creationism, he says:

"Young-Earth creationism, insofar as it gives pride of place to a literalistic interpretation of Genesis, cannot avoid framing the creationist challenge to materialistic atheism as a religion-versus-science controversy. ... Intelligent design, by contrast with creationism, is at root a scientific position and gains its rhetorical edge from this fact" (p. 195).

The problem with this analysis is that ID's main interlocutors have generally repudiated the idea that ID is a scientific position.^{5,6} And while I certainly agree that such responses are *really* bad philosophy and science, the point is that this reflects the general reaction of the scientific establishment to ID. The ID proponent thus ends up ostracized from the scientific guild in much the same manner as the biblical creationist. However, biblical creation, unlike ID, offers a constructive synthesis of the Bible and science, which is a necessary component of any *Christian* approach to science. Therefore, ID remains on the fringe with creationism, but offers limited value to the church compared to a full-orbed Bible–science relationship. The arguments for intelligent design are welcome, *but they are not enough by themselves*.

Science and evolution

The third section focuses on the interface between science and evolution. And, unsurprisingly, it is largely negative. In general, it is well argued. It is also the section that has the least direct relevance to biblical creation. Apart from a summary critique by Günter Bechly of the YEC approach to radiometric dating and something of a mischaracterization of the YEC position on fossil 'transitional forms' (saying that we often say there are 'none'),



Figure 1. Almost all 'different interpretations' of Genesis 1–11 come from old-earth proponents seeking to show that the Bible and deep time are compatible. Intransigent belief in deep time, not a commitment to submit to Scripture above all else, drives this trend.

there is not much at odds with biblical creation in this section.

The essay I found most interesting was "Does Darwinism Make Theological Assumptions?" by Cornelius Hunter. He presents a strong case that Darwin made a *lot* of unsubstantiated assertions about what God *would* do as a crucial element in his argument for evolution in *On the Origin of Species*. This shows that Darwinian evolution is *not* a purely scientific theory, and never has been.

Hard questions on science and faith

The final section is a sort of grab-bag of different issues, addressing matters as diverse as panspermia, multiverse theories, and transhumanism. However, this section also has the most essays relevant to biblical creation, with four out of the 11 having some relevance.

The most directly related is the essay "How Should We Think About the Age of the Earth?", by David Haines. By casting the dispute as fundamentally between 'different interpretations' of Genesis 1–11 (figure 1), he misconstrues the debate. Practically all the 'different interpretations' come from the old-earth camp, and they all serve the same purpose: to argue that the Bible is compatible with deep time. Indeed, most such interpretations arose in the aftermath of, and as a consequence

of, deep time theorizing in the 18th century.⁷ This reveals a deep problem in the practice of *sola scriptura* by many (if not most) OECs. They commonly constrain the interpretations of Scripture they regard as viable to those compatible with deep time. Why? They treat deep time as true with a degree of confidence and intransigence typically reserved for mundane beliefs like sense experience and basic moral beliefs (e.g. the immorality of murder). The upshot is that, in practice, they generally do not allow Scripture to dictate what they should believe on this question; they instead let deep time determine what Scripture can mean.

More than this, though, there are severe salvation-historical problems for OECism, such as placing the fossil record and human death before human sin. William Dembski attempts to address this in his essay "How Can We Make Sense of Natural Evil?". This is essentially a summary presentation of his book *The End of Christianity*, which has been extensively critiqued.⁸ First, he offers a reading of Genesis 1 that says it corresponds to the 'logical' ordering of divine creation in God's mind rather than the chronological sequence of how He produces it in being (p. 530). He contrasts this 'logical' ordering with the "purely contingent facts about the chronology of creation" (p. 530). However, this depends on a distinction not

Image: Brett Jordan, Pixels.com / CCO

present in Scripture, let alone evident in Genesis 1.⁹

Moreover, by contrasting God's 'logical' ordering of creation in God's mind with the 'pure contingency' of its chronology of implementation, Dembski seems to suggest that Genesis 1 offers a logically *necessary* ordering of God's creative intents. However, why *must*, for example, the creation of vegetation (Day 3) have preceded the creation of stars (Day 4) in God's mind? Rather, this seems to be as contingent as the chronology of implementation. If God is free to execute the creative act in whatever sequence He wants, it makes no sense to say that He is constrained to plan the creative act in only one specific way. God is free to execute *and* plan His creative act countless different ways, even with respect to *this* cosmos. Therefore, both are contingent. But if both are contingent, then Genesis 1 cannot be a *logical* ordering of creation in God's mind in contradistinction to the 'pure contingency' of the chronology of its implementation.

Second, Dembski argues for his 'retroactive death' idea, which says that God imposed the effects of the Fall on creation *before* as well as after Adam sinned. This idea has been severely criticized in numerous places.⁷ I offered a summary critique in another review that remains apt:

"However, this reverses the Bible's order—God making a 'very good' world, and *then* God subjected the world to futility *in response* to Adam's sin (Genesis 3:17–19; Romans 5:12–21, 8:19–23). It also implies God never *actually* created a 'very good' world. Moreover, it puts the punishment for the crime before the crime is committed. Furthermore, God *hides* the suffering-filled world from Adam until he sins *so that He can blame Adam for it*. This is deception of the worst kind. Anything but 'very good' and 'God's intended meaning'.¹⁰

Dembski says that his point is merely that "you don't need to be a young-earth creationist to maintain a traditional view of natural evil" (p. 534). Even this limited point, however, is, I

think, a failure. The deep problems and contrived nature of both his reading of Genesis 1 and his theodicy will, I suspect, incline even many old-earthers toward other views.

One other essay that addresses questions of young- and old-earth creation directly is Richard Howe's essay "How Should Christians Think About Origins?". He is a young-earthier, but, like Haines, believes the dispute between OECs and YECs is purely a matter of 'different interpretations'. As mentioned above, this fails to see how deep time constrains the OEC reading of Scripture.

One other essay that has some relevance is "Is Theistic Evolution a Viable Option for Christians?", by Jay Richards. It doesn't address biblical creation directly, and so is a perspective both YECs and OECs can embrace. And he raises a really interesting point about what evolution is taken to mean by its secular expositors:

"Darwinists almost always insist that their theory serves as a designer substitute. That's the whole point of the theory" (p. 436).

So, when we hear responses from theistic evolutionists that are uncompromising in their commitment to a 'natural causes only' picture of evolution but vacillate on whether God guides evolution,¹¹ it simply underscores the difficulty in embracing such 'theistic Darwinism'. One can't marry a divine designer of life with an explanation for life crafted to be a designer-substitute. Either one embraces Darwin's rejection of teleology or one imports teleology into evolution in conflict with the secular consensus. Theistic evolutionists can't have their cake and still eat it too.

Assessment

As one might expect from a compendium with nearly 50 essays from about 30 different contributors, the quality and depth of the essays is uneven. There is also a lot of repetition. And since most people in the ID movement are old-earth creationists, this issue rises at times, and it is explicitly defended

in several essays. Nonetheless, this is a useful resource for any who are interested to get a handle on the origins debate and become aware of the many different issues that surround the conversation between science and Christianity. Plus, it defends a *supernatural* perspective on origins with respect to biology, and biblical creationists can draw on some of the conceptual resources in these thinkers to forge a more Bible-based synthesis of science with Scripture.

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Rationalist superstitions about Christianity and their legacy

Of Popes & Unicorns: Science, Christianity, and how the conflict thesis fooled the world

David Hutchings & James C. Ungureanu

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This book focuses on the many antibiblical narratives promoted by scientist John William Draper (1811–1882; figure 1) and historian-politician Andrew Dickson White (1832–1918; figure 2). They were the authors of the highly influential but deeply flawed books *History of the Conflict Between Religion and Science* (1874) and *A History of the Warfare of Science with Theology in Christendom* (1896), respectively (henceforth *Conflict* and *Warfare*) (figure 3). As shown extensively in this book, these narratives are largely fallacious, but they have acquired a considerable following in many Western institutions. For instance,

the authors write, “Once again, then, we have a clear-cut example of a world largely fooled. The British Library was sucked in. The American Medical Association was tricked. The BBC was hoodwinked” (p. 90).

A summary of Draper and White’s position

Here, based on the books written by Draper and White, is a sampling of the contents of this book:

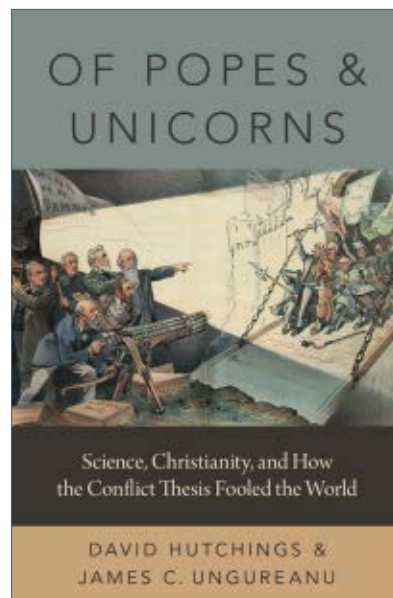
“*Conflict* and *Warfare* spun cautionary tales of flat banned autopsies, Dark Ages, persecuted scientists, burned books, dangerous dogmas, abandoned classics, excommunicated comets, imprudent popes, and unlikely unicorns—in short, of a never-ending battle between science and religion” (p. 218).

The authors add:

“And so *Conflict* was born: a list of tales about how Rome or the popes or priests or doctrine or dogma or Scripture had dealt devastating damage to science and scientists and rationality and reason. A compendium of flat Earths, of medical misdemeanors, of the Dark Ages, of Hypatia, of Bruno, of Copernicus, of Galileo, and all the rest” (pp. 171–172).

The works of Draper and White were nothing less than a demonization of Christianity. Hutchings and Ungureanu almost admit as much:

“For example, *Conflict* and *Warfare* portrayed a Christianity that killed off Greek and Roman science and plunged Europe into the so-called Dark Ages—a thousand



years of fecklessness, stupor, and backward thinking. Christendom, said Draper and White, destroyed ancient libraries; it forbade the study of philosophy; it tormented or tortured or killed anyone remotely scientific lest its hopelessly inaccurate scriptures be exposed” (p. 14).

Pretty lurid stuff!

Draper no atheist, but so what?

Perhaps trying to be ironic, the authors write:

“It might be very easy to picture Draper as a nineteenth-century Richard Dawkins, or Jerry Coyne—but he was, in fact, no atheist . . . Dogma had to go—and so did most of the supernatural claims of Scripture, a divine Jesus, and any assertion about God that came only from revelation. Provided religion was prepared to ditch all this, it would get along with science just fine, thank you very much” (pp. 170–171).

So what exactly of Christianity, in Draper’s thinking, is left? Of what use is it if a person professes not to be an atheist, but believes and repeats all the talking points of atheists? The

authors affirm this elementary fact—a fact not lost on today’s militant atheists:

“The New Atheist writers—the likes of Richard Dawkins and Sam Harris—have been rehashing Draper and White, in one way or another, for years. As an avid polemicist, Dawkins is perhaps the duo’s most famous intellectual descendent ...” (p. 16).

Now Hutchings and Ungureanu do not actually propose an explanation as to why Draper and White have been so uncritically accepted in intellectual circles. Could it be that a vague cultural consensus had emerged by the 19th century, in the West (including among most religious believers) about the Bible being unreliable in factual matters? This would also explain the rather venomous hostility to even potential creationism seen in recent decades. More on this later.

The authors examine the initial appeal of Draper and White’s ideas:

“When Draper and then White’s diatribes arrived on the scene, they provoked quite a reaction. Those who preferred their religion liberal—a loose, ill-defined, choose-the-bits-you-like approach to traditional ideas—were, broadly at least, fans” (p. 177).

In this day and age of even conservative evangelicals increasingly accepting unbiblical notions and lifestyles, this inadvertent warning takes on greater significance.

The moon landing ‘hoax’?

The authors begin by discussing the few who believe that the U.S. never landed men on the moon, but never explain why this is so. Could there be a common spirit of cynicism towards knowledge in general?

Even imagining the moon landing a hoax is beyond fantastic. Hutchings and Ungureanu repeat the fact that there were more than 400,000 NASA employees and that it is impossible

to keep a fake secret with that many people in the know.

This is all well and good, but this, and similar discussions about this subject, overlook a glaring and essential fact. It was the Cold War, and the U.S. and the Soviet Union were then in a race to land men on the moon. If NASA had contemplated faking the moon landing, it would have surely realized that the Soviet Union would be the first to call them out on this egregious hoax. This would have made the United States the laughing stock of the whole world, and would have destroyed the credibility of American international policy. So better not to claim that you landed men on the moon unless you actually did.

Ironically, and again not mentioned by the authors, this process worked in reverse. When the Soviet Union launched Sputnik 1, they knew that the West might try to deny the achievement, and call it a hoax. It is for this reason that the Soviet specialists installed a radio transmitter in Sputnik, so that the reality of the orbiting Soviet satellite could readily be verified, all over the world, by tuning in to the loud ‘beeps’ it gave off as it passed overhead.

The church did not oppose advances in medicine

Draper and White go on a warpath against the Church and blame it for all manner of blocking of the growth of knowledge. Their imagination knows no bounds. Not only are they incorrect, but what they articulate is, at times, an exact inversion of the truth. As an example, the authors of this book turn around the accusation that the Church long prevented research into human anatomy by forbidding dissection. They comment:

“... White’s earlier analysis can be flipped on its head. For, when



Figure 1. John William Draper (1811–1882)

Image: John Sartain (1808–1897), Wikimedia / Public Domain (coloured)

dissection eventually did resurface in the twelfth and thirteenth centuries—which it did, and as a learning tool, no less—it happened under the auspices of Catholicism, in its universities and schools, where it was given both its legitimacy and its sponsorship by the leaders of the Church. Indeed, should we permit ourselves the same level of polemic license as White did, we could put it this way: It was the ancients (Greeks included) who placed a ban on dissection, and the Church that legalized it. We could say that it was Christendom that finally freed medicine from this irrational dogma” (p. 88).

Touché!

The flat earth yet again

Evidently trying to be a bit dramatic, Draper and White enlist the flat earth as one of the Church’s chief thunderbolts. The authors describe the staying power of this onerous flat-earth accusation:

“Such was the force of Draper’s and White’s flat-earth account that it soon became the standard storyline, the definitive discussion,

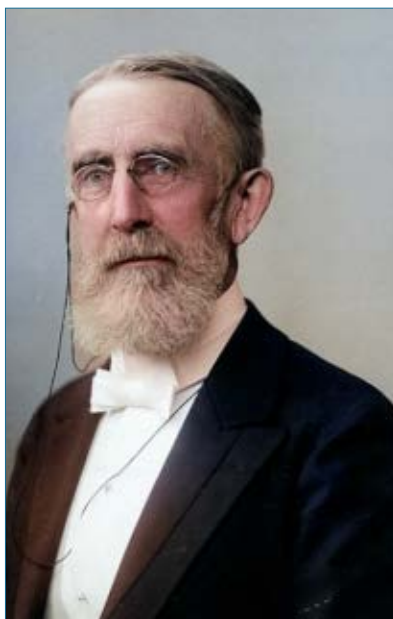


Figure 2. Andrew Dickson White (1832–1918)

the normal narrative. When the next generation or two of historians or commentators wrote on the topic, they simply repeated or embellished the *Conflict-Warfare* account as they saw fit” (pp. 58–59).

In fact, the flat-earth shibboleth very much took on a life of its own. We had, for instance, in our own lifetimes, the grammar-school fiction of Columbus being afraid that he might sail off the edge of the earth (I remember).

The facts blow the flat-earth canard away. The authors remark:

“Thanks to clever scientific reasoning about the Earth’s shadow on the moon, the disappearance of ships over the horizon, the changing lengths and angles of shadows in different cities, and the varied positioning of stars as one moved over its surface, the best thinkers from around 500 BC onward had conclusively nailed down the sphericity of our world. The likes of Pythagoras, Aristotle, and Euclid had got it all mostly figured out a few centuries before

Jesus turned up—and there was, even during their time, a broad consensus about the matter” (pp. 61–62).

Do not blame Christianity for resistance to vaccination

As part of their mendacious narrative in which the Christian religion is a brake on human progress, militant unbelievers have blamed ‘organized religion’ for what today is called vaccination hesitancy. The authors comment:

“It is a similar story with inoculation. [John William] Draper wrote that it had been ‘strenuously resisted by the clergy’—but it hadn’t. There certainly was strenuous resistance, but it was not from the clergy ... Did some individual firebrands denounce it in some churches either side of the Atlantic? Yes. Did the Church, as a unified body, oppose it? Did ‘Christendom’? No. Instead, some of its most influential members, [Cotton] Mather included, were the ones who gave it life” (p. 91).

This issue is not just of historical interest. It is quite relevant because of today’s significant public resistance to COVID-19 vaccination. Many reasons are stated for this hesitancy. People have questioned government motives in mandating vaccination, or expressed concern about the possibility of unappreciated long-term harm from a recently developed vaccine. However, religious belief, *per se*, is rarely a motive for such hesitancy.

The Bible does not teach the existence of unicorns

Unbelievers have long had a field day with the alleged biblical endorsement of the superstition about unicorns (e.g. Psalm 22:21). That is why they are part of the title of this book. Ironically, none other

than brilliant author Isaac Asimov, an atheist himself, soundly laid this rationalistic fairy tale to rest. Hutchings and Ungureanu quote Asimov:

“The Hebrew word represented in the King James Version by ‘unicorn’ is *re’em*, which undoubtedly refers to the wild ox (Urus or aurochs) ... When the first Greek translation of the Bible was prepared about 250 BC the animal was already rare in the long-settled areas of the Near East and the Greeks, who had no direct experience with it, had no word for it. They used a translation of ‘one-horned’ instead and it became *monokeros*. In Latin and in English it became the Latin word for ‘one-horn’; that is, ‘unicorn’” (pp. 117–118).

Superstition is common, even today, and is not the product of religion

Let us put the foregoing in broader context. The fact that we live in an ‘enlightened’ age does not free us from superstition. The authors write:

“Just as superstition seems to be a human constant, so do stories of mysterious beasts ... And, of course, we ourselves indulge in such fantasies—rarely an evening goes by without a mainstream TV channel somewhere searching for the Loch Ness monster, or the Abominable Snowman, or extraterrestrials who, having built the pyramids, are occasionally popping back to the Earth to abduct and probe yokels” (p. 117).

The church did not oppose astronomy—just the opposite

The canned rationalistic attacks on the church’s presumed treatment of Bruno and Galileo did not happen in a vacuum. They began with accusations of the church opposing

astronomical investigation in general, and of relying on the old opinions of the Scholastics in place of empirical observation.

The authors expose this rather asinine caricature of early astronomers:

“Draper, for instance, had said that any medieval astronomical question ‘was at once settled by a reference to the writing of Augustine’, and the Middle Ages had therefore ‘not produced a single astronomer’. This, however, is bunk—on both counts. Firstly, there were thousands of astronomers throughout the length and breadth of Christendom, many of whom were monks, or cardinals, or even popes. Some made their own machines called astrolabes to track the planets and stars; others wrote manuals on how to build them; still others wrote instruction on their correct use—all this is detailed, complete with images of manuscripts” (p. 122).

Science and the Christian faith: a reality check

Hutchings and Ungureanu set the record straight: “Why did so many prominent scientists—Kepler, Boyle, Faraday, Maxwell—attribute their scientific advances so directly to their faith?” (p. 20). Good question.

The authors provide an example of where religious faith actually served as an inspiration to scientific discovery. They write:

“The doctrine of God’s omnipresence, for example, meant that Newton was prepared to allow his gravity to act across the enormous distances of space, and without obvious bodily contact—a possibility that, up to that point, had been considered highly philosophically suspect” (p. 196).

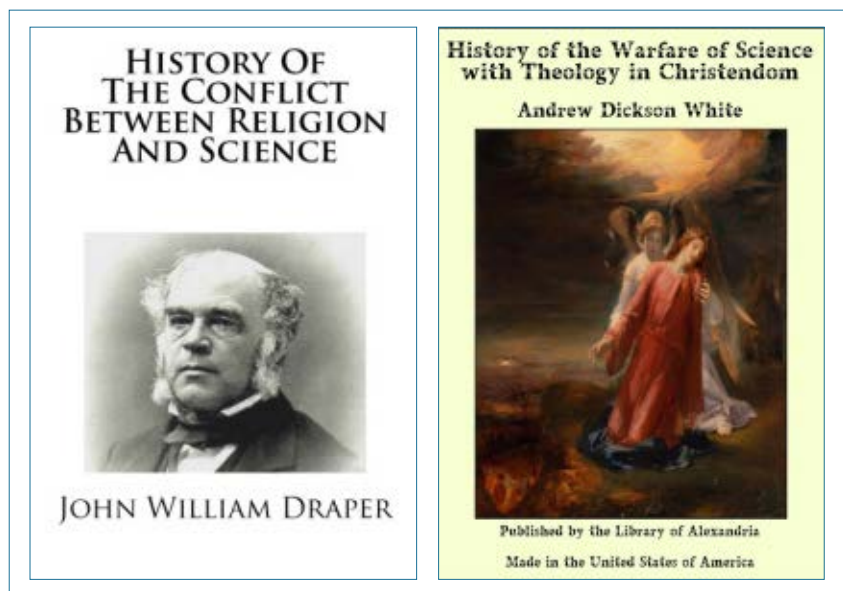


Figure 3. *History of the Conflict Between Religion and Science* (1874) by John William Draper, and *A History of the Warfare of Science with Theology in Christendom* (1896) by Andrew Dickson White. Both books were highly influential but deeply flawed.

The Draper–White thesis lives on, and does harm to science

It would be incorrect to think of rationalistic notions and their consequences as abstract academic matters, or of being safely confined to the armchairs of the 19th century. With reference to events today, Hutchings and Ungureanu provide several examples of how religious believers have been discriminated against in scientific circles, all under the pretence that they are some kind of ‘adversaries of science’. The authors summarize the situation:

“In fact, right now, instead of a shared understanding, we have papers retracted for accidentally mentioning a creator; we have enforced resignations; we have accusations of ‘dementia’; we have discrimination in the workplace. We have our intellectual guardians loudly promulgating wrong ideas; we have a majority of school students declaring, incorrectly, that ‘the scientific view is that God does not exist’. We have evolutionary theory hauled out, by both sides, as a

shibboleth—and anyone who gets the answer wrong is considered as good as dead to their community. In short, we have conflict. We have warfare” (p. 215).

Conclusion

The falsehoods of Draper and White are easily laid to rest, but they raise the question why a sledgehammer is even needed to crush the gnat. Clearly, Draper–White style rationalistic myths have nine lives. But why? Myths persist because they fulfill needs, and evidently there is some kind of deep-seated societal need to discount the full truth of the Bible. Ironically, however, Draper–White style falsehoods tell us more about the mentality and prejudices of those who repeat them than they do about any defects in Scripture.

Misrepresenting creationism

Early Christian Readings of Genesis One

Craig Allert

IVP Academic, Downers Grove, IL, 2018

Joel Tay

Craig Allert is Professor of Theological Studies at Trinity Western University. This school is well known as a hotbed of theistic evolution. Many vocal evolutionists teach there, including Dennis Venema, a Professor of Biology, and Arnold Sikkema, a Professor of Physics. Allert authored this book as a polemical response against young-earth creationists (henceforth shortened to *creationists*). The tone is abrasive and filled with invective against his opponents. For example, he is “appalled” (p. 4) by creationists who “plunder the church fathers for ammunition” (p. 71).

As an avid student of the patristic writings, I found Allert’s book to be tedious—not so much because he quotes the Church Fathers at length, but due to his inability to grasp the nuances of creationist literature. Hence, the bulk of the book revolves around a number of careless and misguided charges against his creationist opponents. Allert accuses creationists of ‘quote mining’ the Church Fathers. He denounces creationists for imposing contemporary evangelical hermeneutics (i.e. the historical–grammatical method) upon the Church Fathers. Thus, the central thesis of his book is that creationists are guilty of decontextualizing and proof-texting the patristic writings, misappropriating them to support their preconceived views of Genesis.

Literalists vs allegorists

Allert cautions his readers not to take the Church Fathers as if they are a monolithic body in doctrine and practice. Evangelicals must be especially careful not to read the Fathers through a post-Reformation lens, looking for Protestant doctrines in their writings.

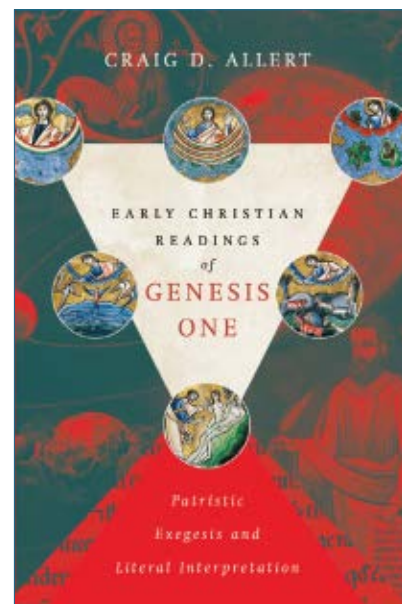
He takes issue with creationists who appeal to Basil as one who believes in a young Earth. He rejects the idea that Basil was a ‘literalist’ and devotes considerable space to discussing Basil’s allegorical views. One whole chapter is devoted just to Basil, where he argues that Basil depended heavily on allegory.

Allert criticizes CMI, ICR, and AiG for misappropriating the Church Fathers. According to Allert, the biggest error made by creationists is that they artificially divide the Church Fathers into two rigid schools—the Alexandrian school and the Antiochene school. Creationists regard the Antiochene school as literalists—those who read Genesis literally. These are ‘the good guys’.

The Alexandrian school are the allegorists—‘the bad guys’. Allegorists include Clement of Alexandria, Origen, Ambrose, and Augustine of Hippo. According to Allert, creationists chastise the allegorists for reading the Bible the way they do, and, in so doing, brush aside their interpretation of Genesis. Then, according to Allert, creationists turn around to exalt the literalists, reading them through a post-reformation, protestant lens.

Grammatical–historical method

Creationists, according to Allert, teach that the Antiochene Church Fathers—the good guys—depended on



a grammatical–historical approach of exegesis. But a grammatical–historical approach is a modern hermeneutical construct. Thus, by misappropriating the Fathers, creationists twist the words of the patristics out of context to ‘support’ their interpretation of Genesis. Allert writes:

“Organizations like AiG and CMI appropriate the church fathers as advocates of a nascent creation science position. But even more foundational than this is the claim that the authors of the New Testament and ‘theologians since the Fathers’ were practitioners of the GH [i.e. the grammatical–historical] method of interpretation” (p. 107).

As far as CMI is concerned, this statement is profoundly untrue. As an organization that affirms the doctrine of biblical inerrancy, CMI adheres to the grammatical–historical method of interpretation—proudly so. This is the method explicitly described in the Chicago Statement on Biblical Inerrancy (CSBI). CSBI states:

“Article XVIII

We affirm that the text of Scripture is to be interpreted by grammatico-historical exegesis, taking account of its literary forms and devices,

and that Scripture is to interpret Scripture.”

Thus, in rejecting the grammatical–historical method in his book, Allert necessarily rejects the doctrine of inerrancy as historically defined in CSBI—he has to, since he is an evolutionist. Notably, the Chicago Statement on Biblical Hermeneutics (CSBH) also states that a belief in evolution constitutes a denial of inerrancy:

“Article XIX

... We deny that Scripture should be required to fit alien preunderstandings, inconsistent with itself, such as naturalism, evolutionism, scientism, secular humanism, and relativism.”

While CMI abides by grammatical–historical hermeneutics, CMI has never said that the Antiochene Church Fathers always stuck firmly to the grammatical–historical method. The Church Fathers were certainly consistent with the grammatical–historical principle in the sense that, at the foundational level, they affirmed the inerrancy and historical reality of Genesis. We have also explained that there are only a couple of individuals from the Alexandrian school who taught that the creation days were instantaneous—not million-year periods.

Rather, as creationists have always pointed out, even some of the Antiochenes resorted to allegory—but this allegory is always drawn out, based on a prior foundational acceptance of Genesis as a historical account.

Unfortunately, Allert’s unfamiliarity with the nuances of creationist literature meant that he spent significant space in his book attacking a strawman. It is the historical acceptance of Genesis by the Church Fathers that can be likened to the grammatical–historical method. Note that this is different from saying that the Church Fathers only used the grammatical–historical method. In



Image: Philippe de Champaigne (1602–1674), Wikimedia / Public Domain

Figure 1. Although Augustine of Hippo came from the Alexandrian school of interpretation, he affirmed the historical reality of the Genesis account, and the belief in a literal Garden of Eden with a real Adam and Eve who fell into sin.

contrast, the emphasis on Genesis as a real historical account by the Church Fathers flies in the face of the historical–critical method of interpretation that Allert proudly extols in his book.

Here we see another conundrum in Allert’s thought process. On one hand, he claims that creationists say that the Church Fathers used the grammatical–historical method, and on the other hand, he argues that creationists have placed the Church Fathers into two rigid ‘literal vs allegorical’ camps. Well, if creationists have placed the Church Fathers into two strict camps, then it should be obvious that they cannot all be using the same grammatical–historical method consistently—and CMI doesn’t claim that they did!

CMI affirms the grammatical–historical method, and we believe the Church Fathers ought to have done the same. Nevertheless, we have always recognized that the Church Fathers have not always been consistent in doing this. So CMI’s position is actually the opposite of what Allert asserts. For example, creationists have long pointed out that some of the Church Fathers were prone to allegory

in their reading of Scripture (i.e. not historical–grammatical).

Out of the massive body of literature that constitutes the Church Fathers, there are only three Early Church Fathers that took a figurative understanding of creation days.¹ Clement of Alexandria, Origen, and Augustine of Hippo (figure 1). All three of them come from the Alexandrian school of interpretation, which leaned towards allegory. Being heavily influenced by Greek philosophy, they believed that Creation Week was instantaneous, not six days. Yet, we do not know of a single Church Father who taught that the earth is millions of years old. Why? Because the Church Fathers, Antiochene and Alexandrian alike, recognized the importance of affirming the historical reality of the Genesis account, together with a belief in a literal Garden of Eden, with a real Adam and Eve, who fell into sin, bringing physical death, spiritual alienation, and sin into this world.

All three of these ‘Alexandrians’ taught that the earth was only thousands of years old, in contrast to the ancient Greeks, who believed that the universe was ancient. For example, Augustine, in his most famous work,



Figure 2. Basil was heavily influenced by Greek philosophy, but still affirmed a literal six-day Creation Week, and taught that the space of a creation day was made up 24 hours.

City of God, has a whole chapter, *Of the Falseness of the History Which Allots Many Thousand Years to the World's Past*, where he says:

“Let us, then, omit the conjectures of men who know not what they say, when they speak of the nature and origin of the human race. ... They are deceived, too, by those highly mendacious documents which profess to give the history of many thousand years, though, reckoning by the sacred writings, we find that not 6000 years have yet passed.”²

Misrepresenting creationism

CMI denies that the Church Fathers constitute a monolithic body that can be divided into two rigid camps: ‘literalist’ and ‘allegorical’. Yes, there are two main schools of interpretation, the Antiochene school, and the Alexandrian school. Almost all Patristic scholars recognize this—even Allert. The Alexandrian school of thought tended to allegorize their interpretation of biblical passages, while the Antiochene camp generally tried to avoid wild allegorical speculation. But this is not what Allert is

saying. Allert accuses CMI of teaching that there is a strict rigid demarcation between the two camps, where one is either allegorical (the bad guys), or literal (the good guys).

But where has CMI drawn this demarcation of ‘literalist-only’ vs ‘allegorical-only’? Basil (figure 2), as Allert points out, is often classified as an Antiochene. CMI agrees. In fact, CMI has previously pointed out that Basil was rather sympathetic to the allegorical interpretation of the Alexandrian school. Allert doesn’t seem to be aware that CMI has actually said this, showing again, his poor grasp of creationist literature. He then goes on to devote an entire chapter—filled with invectives and what not—to refute this strawman. Consider the writings of CMI’s Andrew Sibley:

“Basil, the Cappadocian saint (AD 330–379), acknowledged the ‘laws of allegory’, but also emphasised the literal sense in his *Hexaemeron* (meaning ‘Six Days’). This was written in elegant prose to be presented as a set of homilies or sermons. It was didactic, that is designed to appeal to the senses and be informative, and in this case expressing both symbolic meaning and literal truth.”³

It should be obvious from the above quotations that Allert’s complaint does not hold any water. We should not miss the obvious here. As much as Allert quotes Basil as one who uses allegory extensively, Basil, in his writings, nevertheless affirmed both a literal six-day Creation Week and 24-hour days, and taught that “24 hours make up the space of a [Creation] day”.⁴

Thomas Aquinas certainly understood Basil that way—teaching ordinary-length creation days:

“The words ‘one day’ are used when day is first instituted, to denote that one day is made up of 24 hours. Hence, by mentioning ‘one’, the measure of a natural day is fixed. Another reason may be to signify that a day is completed by the return of the sun to the point from which it commenced its course. And yet another, because at the completion of a week of seven days, the first day returns which is one with the eighth day. The three reasons assigned above are those given by Basil (Hom. 2[8] *Hexaem.*).”⁵

Yet Allert simply glosses over this important point. It is not just Basil. CMI has also pointed out that the same can be said about the other Church Fathers who used allegory. The Fathers drew out their analogies after first affirming the historical reality of the Scripture. This is not a case of historical *or* spiritual, but historical *and* spiritual. For example, In *Origen, origins and allegory*, Sibley points out that while Origen (figure 3) held to an allegorical interpretation of Genesis, he also read it historically:

“All early theologians, including Origen, read Scripture historically and spiritually, even if Origen read the six-day creation account allegorically. The second response is in relation to Origen’s writing regarding Adam and the Fall, and the third, in relation to the age of the earth. It becomes clear that Origen believed in a real Adam, created physically in the recent past, who was the progenitor of all

created physically in the recent past, who was the progenitor of all humanity. Origen also spoke against the Epicurean beliefs of Celsus, beliefs now inherent in Darwinian evolution, and so his teaching cannot be properly used to support theistic evolution Origen's three levels of biblical interpretation were divided into the literal sense, the moral sense, and the allegorical sense."⁶

As proof, Origen, in his refutation of the anti-Christian Celsus, wrote:

"... Celsus, from a secret desire to cast discredit upon the Mosaic account of the creation, which teaches that the world is not yet ten thousand years old, but very much under that, while concealing his wish, intimates his agreement with those who hold that the world is uncreated."⁷

Allert concedes in his book that, unlike him, the Church Fathers were not evolutionists. Neither does he think that we should adopt the hermeneutical methods of the early church. In rejecting the grammatical–historical method, he gravitates towards the historical–critical method of interpretation that is popular with most liberal theologians today. He believes that the Church Fathers were wrong about creation. Nevertheless, he is appalled that creationists claim patristic support for their view of creation. He blames this on the modern evangelical ignorance of the Church Fathers.

Allert's departure from the Church Fathers should not surprise us. After all, there is not a single Church Father on record who taught evolution. So if it were true that we ought to follow the Church Fathers in their interpretation, Allert would actually end up refuting his own view. However, Allert sweeps this under the carpet and takes aim at creationists, who, in his view, do worse for wrongly teaching that the Church Fathers held to a grammatical–historical method of interpretation, and



Image: Guillaume Chaudière (1584), Wikimedia / Public Domain

Figure 3. Origen defended the Mosaic account of the creation, which teaches that the world is less than ten thousand years old, in contrast to the ancient Greeks who believed that the universe was ancient.

for putting them into two strict literalist vs allegorist camps.

Now, the careful reader would have noted, from the earlier quote by Sibley, that creationists are well aware of this! Sibley explained that Origen practised three levels of biblical interpretation that can be divided into the literal sense, the moral sense, and the allegorical sense. It should be obvious that in this discussion about Origen's allegorical interpretation, CMI is saying that the Church Fathers are not always consistent in practising the principles that we now call the grammatical–historical method of interpretation. So how can Allert say that creationists insist that the Church Fathers were practitioners of the grammatical–historical method? CMI said the very opposite, pointing out that some of the Church Fathers strayed beyond the grammatical–historical approach into allegory.

Likewise, Allert implicitly suggests that just because some of the Church Fathers appealed to allegory, we do not have to take Genesis as historical. But far from rejecting the historicity of Genesis, the Church Fathers affirmed the biblical record as the inerrant Word of God. Now, some of them would go

on to draw out additional allegorical or spiritualized ideas from the text that go beyond the grammatical–historical context, but they do not reject the historical reality of the passage. Rather, the allegorical analogy is explicated as *an add-on* to the foundational historical reality of the text.

For example, the Church Fathers often interpreted the six days of creation as analogical to the future millennial kingdom, where the earth will exist for 6,000 years followed by a 1,000-year millennial reign. However, just because the Church Fathers identified analogical patterns or allusions between the Old and New Testament, it does not mean that they rejected a plain reading of Genesis days. In fact, it is often because they took Genesis historically, that they begin to draw these allegorical links between the Old and New Testament. Further, most of the Church Fathers asserted that we are not yet in the Millennium because the earth was not even 6,000 years old at the time of writing. E.g. *Irenaeus* (125–202) wrote:

"For in six days as the world was made, in so many thousand years shall it be concluded. ... For that day of the Lord is a thousand years;

and in six days created things were completed: it is evident, therefore, that they will come to an end at the sixth thousand year.”⁸

Here, Allert is guilty of erecting a false ‘literalist vs allegorist’ dichotomy, which he then projects onto creationists.

Allert proceeds to discuss several other Church Fathers in his book, using this false dichotomy as a central theme in his book. One example is Theophilus of Antioch. In his interpretation of the first six days of creation, Allert points out that Theophilus uses a lot of typology and allegory. When Theophilus speaks about God’s creation on the fourth day, he explains that “because the sun is greater in brightness and power than the moon, the sun is a ‘type’ of God and the moon a ‘type’ of man.” Once again, Allert fails to see that behind this typology lies a strict appeal to the historicity of the text. Theophilus also taught that the creation days were six literal days. He even affirmed the historical order of Creation in Genesis, where the creation of the sun on the fourth day, a day after the plants, served as a refutation of pagan sun-worshipping worldviews.⁹

Conclusion

In other words, while Allert accuses CMI of misappropriating the Church Fathers, he is the one who is guilty of misappropriating creationists. Allert’s error is subtle, but significant. This is because his entire thesis pivots on the claim that creationists have misappropriated the Church Fathers. He devotes an inordinate amount of time pointing out that Basil, from the ‘literalist’ Antiochene camp, wrote allegorically about creation in many places. But every major critique that Allert musters against creationists turns out to be due to his lack of grasp of creationist literature.

CMI has always been careful to note that there is an overlap in the way both schools of thought interpreted biblical

passages. The rigid ‘literalist-only’ vs an ‘allegorical-only’ school of thought is an invention of Allert’s own making. Neither is CMI guilty of saying that the Church Fathers always practised the historical–grammatical method of exegesis. Instead, CMI points out that some of the Church Fathers wandered into allegory. Yet even those that did so held to the historical reality of Genesis as the basis for their allegorical interpretation. Finally, as CMI has always pointed out, and which Allert has never shown to the contrary, there is not a single Church Father that can be shown to have taught millions of years.

Allert needs to show more than just how some of the Church Fathers interpreted Genesis allegorically. To defend his thesis, Allert has to show that the Church Fathers who allegorized biblical passages, did so by first rejecting the historical reality of the Genesis passages. He fails to do this. Allert’s inability to show a single example in his entire book serves to bolster the case that the Church Fathers universally believed in a recent creation.

Lastly, while Allert discusses Augustine, he fails to inform his readers that Augustine was not only a creationist who believed the world was not even 6,000 years old at the time of writing, but he was perhaps the most important Church Father on the doctrine of Original Sin. This led to what became known as the Pelagian controversy. Yes, Augustine, the ‘allegorist’, regarded it of utmost importance to affirm a historical Adam and Eve who brought sin, physical death, and spiritual alienation and suffering into this world. Subsequent church councils expounded on this doctrine in even more detail, and a denial of this was declared to constitute the Pelagian heresy (cf: Council of Carthage (419), and the Second Council of Orange). These creeds would condemn most theistic

evolutionists today as heretics, with the threat of excommunication! This is because most theistic evolutionists do not believe that Adam (if they even believe in such a person), was immortal until he sinned. The Council of Carthage (419) declares:

“That whosoever says that Adam, the first man, was created mortal, so that whether he had sinned or not, he would have died in body—that is, he would have gone forth of the body, not because his sin merited this, but by natural necessity, let him be anathema.”¹⁰

Allert not only fails to show that creationists are wrong in their interpretation of the Church Fathers, but the very church history he appeals so strongly to condemns him as a heretic. The irony cannot be overstated.

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Biblical chronology and the oldest 'Yahweh' and 'Israel' inscriptions: their significance for the traditional 1446 BC Exodus date

Gavin Cox

This article discusses how biblical chronology is constructed and how the traditional Exodus date of 1446 BC is calculated and corroborated. Four supporting evidences are discussed, which can be dated to Egypt's 18th Dynasty onwards. Specifically, inscriptions bearing the divine name 'Yahweh', and the earliest inscription of 'Israel' appear at the right time for the early Exodus date. 1) The oldest Egyptian inscription referring to 'nomads of Yahweh' occurs at Soleb, Nubia. 2) A Book of the Dead papyrus (Princeton Pharaonic Roll 5) bears a theophoric personal name utilizing 'Yahweh', likely meaning the owner was a 'Semitic'/Jewish elite, buried in Egypt. 3) The oldest proto-Hebrew inscription, mentioning Yahweh, comes from Mount Ebal, Israel. 4) The oldest Egyptian inscription of national 'Israel' is dated between 18th–19th Dynasties. The combined evidence strongly militates against the late Exodus date of c. 1267 BC.

'Yahweh' inscriptions as chronological markers

Moses defied the might of Egypt, Pharaoh, and their gods with challenges to their assumed divine authority (cf. Exodus 12:12). Scripture tells us of their stand-off, and the ten mighty plagues sent by God that ravaged the land—because Pharaoh would not 'let the people go'. Pharaoh's reason is stated clearly: "Who is the LORD, that I should obey his voice and let Israel go? I do not know the LORD, and moreover, I will not let Israel go" (Exodus 5:2).

In the Hebrew Bible, the divine name 'Yahweh' is spelled יהוה, and pronounced in English with vowels 'a' and 'e'.¹ This name, known as the Tetragrammaton, meaning 'consisting of four letters', was expounded to Moses by God at the burning bush on Mount Horeb (Exodus 3:12–15). It means something like "the one who is: i.e. the absolute and unchangeable one; the existing, ever living."² The name itself was previously known. For instance, Moses's mother's name, Jochebed (יְחֻכְבֵּד) (Exodus 6:20; Numbers 26:59), means "Yah(weh) is power" (HALOT-3647), or "Ya(h)u is glorious" (BDB-2350). Also, the name Joseph (יוֹסֵף) (Genesis 30:24 ff) means "may Ya(h)u add/ Yah(weh) added" (HALOT-3664). The existence of such theophoric personal names containing Ya(h)u is consistent with the history narrated at Genesis 4:26; "At that time people began to call upon the name of the LORD [Yahweh]." Thus, people identifying with Yahweh (even before the revelation to Moses) would incorporate the divine name into their personal names.

It is clear from the Exodus account that the pharaoh of the Exodus did not know or recognize the name of the one true God, the Lord of Heaven and Earth—worshipped by the Israelite slaves. Egypt worshipped around 2,000 gods and

goddesses throughout its history,³ and, not surprisingly, the name Yahweh cannot be found among them.

Furthermore, God said to Moses at the burning bush encounter: "This is my name forever, and thus I am to be remembered throughout all generations" (Exodus 3:13), and later "all the peoples of the earth shall see that you are called by the name of the LORD, and they shall be afraid of you" (Deuteronomy 28:10).

So, when it comes to Egyptian inscriptions, we should expect that 'Yahweh' would appear around the time of the Exodus date, and *not* before it. That being the case, the oldest known Egyptian inscriptions of the name Yahweh should appear around this time or later. Before we investigate the evidence, the date of the Exodus needs to be established.

First things first: establishing the Exodus date

Firstly, how is the date of the Exodus determined? Egyptologist Douglas Petrovich explains:

"... the central text for this crucial historical event, 1 Kgs 6:1, connects the exodus to later Israelite history by noting that Solomon began constructing the Temple in the 480th year after the exodus, signifying an elapsed time of 479+ years. All but the minimalists agree that the counting of the 479+ years should begin with May of 967 or 966 BC, depending on whether one accepts Young's or Thiele's version of Solomon's regnal dates. Thus the 479+ years began either in 1446 or 1445 BC, either of which can be substantiated by the biblical text ..."⁴

The question of the dating of Solomon's temple foundations, which has been meticulously addressed by

chronologists like Ussher, Thiele, Young, and Steinman to increasing degrees of accuracy, will not be addressed here.⁵ Once that date is determined, a biblical Exodus date of 1446/5 BC is immediately apparent, when the Bible's internal evidence is taken at face value.⁶

An independent check

Biblical chronologist Rodger Young identified an independent check for the 1446 BC Exodus date, based on information from Leviticus 25:8–10 and Ezekiel 40:1. This corroborates historical information passed down the generations in the Jewish written records of Seder Olam and the Talmud (b. *Arak. 12a* and b. *Meg. 14b*). The Jewish calendar was meticulously kept by the Jewish scribes for centuries after the Exodus, using the Sabbatical (seven year) cycles and the Jubilee (49 year) cycles, which were independent checks for accurate calendrical counting. Young states:

“In Lev 25:8, Israel was commanded to count the Sabbatical cycles, and if the Sabbatical and Jubilee cycles were being used for calendrical purposes ... then the Jubilee cycles would also have been counted.”⁸

Young further explains that the last Jubilee should have been celebrated (but wasn't, due to the Babylonian captivity) 14 years after the Babylonian king Nebuchadnezzar destroyed Jerusalem. This is gleaned from information given in Ezekiel's prophetic vision (Ezekiel 40:1):

“... counting for the Sabbatical and Jubilee cycles started in 1406 BC, and that Israel's priests were faithful over the years in proclaiming the Sabbatical and Jubilee years, blowing the shofar every forty-nine years to a

largely unheeding people, until that tragic day fourteen years after the destruction of the city when it was time once again for a Jubilee but it could not be observed because the people were captives in a foreign land.”⁵

The Jerusalem Temple destruction is a very certain fixed point in history which Young explains:

“The capture took place in the month of Tammuz in the summer of 587 BC, which was in the year that began in Tishri (the fall) of 588 BC by Judean court reckoning. Fourteen years later was the year beginning in Tishri of 574 BC.”⁵

This becomes a firm anchor for back-calculating a strong chronological backbone to the 1446 BC Exodus date. Young helpfully does the calculation for us:

“... an easy way to check whether the reported Jubilee number is reasonable is to do the arithmetic. If the seventeenth Jubilee was due in 574 [BC, month Tishri 't'], then the first Jubilee, sixteen cycles earlier, was due in $574t + (16 \times 49) = 1358$ [BC, month Tishri]. The year starting in Nisan of 1358 BC was therefore the forty-ninth year of the first Jubilee cycle, in accordance with Lev 25:8–10. The first year of that cycle, forty-eight years earlier, was the year that began in Nisan of 1406 BC.”⁵

All that is needed is to add on Israel's 40 years' wilderness wandering and an Exodus date of 1446 BC is established, backdated from the destruction of Solomon's temple. This perfect synchrony is an independent check, and testimony to the accuracy of the Jewish scribes who faithfully kept the calendar after their Exodus from Egypt (Exodus 12:2).⁶

A further biblical confirmation comes from Judges 11:26, where Jephthah (living in the latter half of the Judges period, maybe 100 years prior to David, crowned c. 1010 BC) refers to Israel occupying the land east of the Jordan for the previous 300 years. Adding another 40 years for the wilderness wandering approximately places the Exodus around 1450 BC, which is in the right ballpark.

Secular synchronisms

A third chronological anchor point, which corroborates the destruction of Solomon's Temple, is the date given by the Babylonians themselves, which is in synchrony with the biblical date. Young explains:

“The Babylonian Chronicle [figure 1] says that Jehoiachin was captured on Adar 2 of 597 BC, so that his first year of captivity was in the Judean regnal year that began in Tishri of 598 BC.”⁵

Around 45 Babylonian clay tablets, inscribed in Akkadian cuneiform texts, were acquired in 1896, and are held in the British Museum. The tablet dealing with Jerusalem's



Figure 1. *Nebuchadnezzar Chronicle*, clay tablet, New Babylonian chronicle for years 605–594 BC



Figure 2. Bronze kneeling statuette of Pharaoh Necho (I/II)

Image: Jona Lendering, Wikimedia / Public Domain

Image: Keith Schengill-Roberts, Wikimedia / CC BY-SA 3.0

destruction is held under the catalogue number 21,946.⁹ Its dimensions are 8.25 cm (3.25 in) tall by 6.19 cm (2.44 in) wide. The British Museum curator's online note states the following:

"Babylonian Chronicle. This historical chronicle describes Nebuchadnezzar's first campaign against Jerusalem in 597 BC. The tablet covers the period of 12 years from the 21st year of Nabopolassar (605 BC, which was also Nebuchadnezzar's accession year), through to the 11th year of Nebuchadnezzar's reign."¹⁰

Biblical scholar David Noel Freedman discussed the pertinent section of the chronicle (English translation by D.J. Wiseman) that deals with Jerusalem's capture:

"The siege and capture of Jerusalem are described as follows: 'In the seventh year, the month of Kislev, the king of Akkad mustered his troops, marched to the Hatti-land, and encamped against the city of Judah and on the second day of the month of Adar he seized the city and captured the king. He appointed there a king of his own choice (lit. heart), received its heavy tribute and sent (them) to Babylon.' There can be no doubt that the captured king was Jehoiachin, while the appointed one was Zedekiah [2 Kings 24:17]. We thus have a fixed date not only for the capture of Jerusalem, but also for the chronology of the last kings of Judah"¹¹

A fourth chronological synchronism is with Egypt, specifically Pharaoh Neco (Necho II, 26th Dynasty, 610–595 BC; figure 2). He was defeated at the Euphrates River at Carchemish by Nebuchadnezzar, king of Babylon, in the fourth year of Jehoiakim (Jeremiah 46:2).⁸

The date of Jerusalem's destruction is therefore very secure, involving biblical, Jewish, Babylonian, and Egyptian sources. From that anchor point, using both the biblical and Jewish sources for Jubilees, a secure date for the Exodus of 1446 BC is established. But what of the knowledge of the name of Yahweh in relation to this date? Is there evidence that affirms God's promise to Moses, that Yahweh's name "would be remembered throughout all generations" (Exodus 3:13)?

1) The oldest Egyptian Yahweh inscription

An 18th Dynasty temple at Soleb, Sudan, is dedicated to Amun-Ra and Pharaoh Amenhotep III (c. 1387–1348 BC) the ninth king of the 18th Dynasty (figure 3), son of Thutmose IV and his mother Mutemwiya. Soleb is an ancient Nubian archaeological site, in Sudan, located north of the third Nile cataract, on the western side of the river. First discovered and described by Karl Richard Lepsius (published 1849–1859)¹² the site consists of a vast necropolis with small tomb chapels decorated with pyramid symbols, and the earliest royal tombs dating to the 18th Dynasty. Although not buried there, pharaohs Amenhotep III, Akhenaten, Tutankhamun, and Ay added further work to the temple buildings at Soleb. Later

modifications were made during Ramesside and Meroitic periods.

Amenhotep III's temple originally displayed extensive wall depictions of his *Heb-Sed* festival.¹³ The monument reveals much important information regarding 18th-Dynasty history, politics, and religion. Amenhotep's throne name, 'Neb-maat-Re' (Lord of truth is Re),¹⁴ can still be seen on the underside of one surviving hypostyle architrave (beam) (figure 4).

The second courtyard of Amenhotep's temple is completely destroyed, except 24 columns belonging to the hypostyle hall are preserved, along with much of their decoration (figure 5). On the columns are inscriptions of Egypt's enemies, shown as foreign, bound captives. They are kneeling, with their arms tied behind their backs, and their names inscribed in crenellated name rings (cartridges). Their faces show distinctive details such as beards, hairstyles, or jewelry, representative of different tribal groups (figure 6). These are organized according to geographical order.

Between 1957–1963 excavations were led by Michela Schiff Giorgini. Her team uncovered the remains of the hypostyle hall and reconstructed it using the available pieces which had been excavated.¹⁵ Each column was found to contain between 8 and 10 cartridges; some are completely eroded, others were left empty by the scribe.¹⁶ Of the conserved columns, one in particular has "piqued the attention of scholars in numerous fields of archaeology, history, language, and religion."^{15,17,18} The inscription of interest resides on 'column 4' and is partly eroded with the bound captive mostly missing. The bust cartridge, which is also heavily weathered, contains the following letters: *ṯ šꜣsw i-h-wꜣ-ꜣ* (figure 7). This name was also copied by Ramesses II on his 19th-Dynasty monument at nearby Amara West,



Figure 3. Colossal statue of Amenhotep III in the British Museum

Image: A. Parrot, Wikimedia / Public Domain



Figure 4. Amenhotep III throne name, 'Nub-maat-re', on underside of surviving architrave



Figure 5. Amenhotep III 18th Dynasty Amun temple at Soleb, Sudan



Figure 6. Amenhotep III hypostyle hall, Soleb, showing bound ethnic prisoners with name rings

which serves as textual confirmation. A fragmentary wall block (SB 69, Sector III, 2nd court), originally from Soleb, also bears the same phrase.¹²

Following the word order, the translation is correctly understood as “land of the nomads of Yahweh”.¹⁵ It can be broken down in the following manner (the hieroglyphs in the cartouche are read from top to bottom and right to left)¹⁹:

𓏏 [N16] *t3* “earth; land; ground” (Wb 5, 212.6–216.7).

𓏏𓏏𓏏 [M8 “pool with lotus flowers”, M23 “upper Egyptian plant”, G43 “quail chick”] *š3-s-w* “Shasu-beduin” (Wb 4, 412.10–11) (note, short form).

𓏏𓏏𓏏𓏏 [M17 “reed”, M17 “reed”, O4 “reed shelter in fields”, V4 “lasso”, G1 “vulture”] *y-h-w3-3* (“*Yhw3*”).²⁰

Archaeologist Titus Kennedy states that the final letter in the divine name has been misidentified as a ‘u’ vowel (G43 quail chick sign) and instead suggests a letter aleph (G1 vulture sign). I don’t find this entirely convincing; the final sign looks like the quail chick, judging by Schiff Giorgini’s original cartouche outline (figure 8), in which case the divine name spells *i-h-w3-w* “*Yhw3w*” as per previous translations. But whichever is more accurate, it is an Egyptian rendering of a non-Egyptian divine name.

Who were the “Nomads of Yahweh”?

The geographical context of the *t3 š3sw i-h-w3-3* cartouche is made clear by its association with six other hypostyle column cartouches bearing the prefix *š3sw* (nomad)—specifically from the greater Canaan region, and what the Egyptians referred to as Edom. These names are known from toponym lists from the Mid to Late Bronze Age.^{21,15} The “hill-country, foreign land” hieroglyph (𓏏, N25) is notably absent from the *š3sw* inscription, further indicating their non-settled state. That being said, the divine name is associated with the nomad group, rather than a geographical region, meaning the nomads are being associated with the divine name Yahweh, rather than as a place name. Kennedy points out:

“Egyptian texts of the New Kingdom often mention nomadic people living east of Egypt, even specifying that some were tent dwellers—the *š3sw* are specifically referred to as tent dwellers in Papyrus Harris I, 76:9–10, which further suggests the mobile lifestyle of a nomad.”¹²

Furthermore:

“The Amarna Letters and 18th- and 19th-dynasty Egyptian texts repeatedly mention nomadic people such as *š3sw*, *sutu* [nomads], and in some cases possibly ‘*apiru*, living in Canaan and the adjacent wilderness areas during the period in which the *š3sw* cartouches were inscribed at Soleb.”¹²

“Nomads of Yahweh” are *anyone but* Israel!

From a biblical perspective, it should be obvious that these “Nomads of Yahweh” are the Israelites who had just entered Canaan under Joshua, having completed 40 years of wilderness wandering under Moses. However, liberal biblical scholarship is wedded to the idea that Israel developed slowly in Canaan, and were themselves offshoots of the Canaanites. Furthermore, they believe the stories of the Exodus, Moses, and Israel’s conquest of Canaan under Joshua are mythical. These were supposedly written down by anonymous editors, centuries later, during the time of the Babylonian Exile (c. 586–516 BC), or even after.²² This is why the “Nomads of Yahweh” are *anyone but* Israel! For instance, biblical scholar S.H. Horn states, of the Soleb inscription:

“Whether one of the Edomite tribal names bearing the name Yahweh implies that Edomites were followers of the god Yahweh or whether the name of the tribe has only a curious coincidence with the name of the Israelite god is still undecided.”²³

In a similar vein, Egyptologist Donald B. Redford stated:

“The localization of the ‘Land of the Shasu’ in the mountainous districts of Se’ir east of the Arabah has an interesting consequence for one name in the mentioned lists from Soleb and Amarah—‘Yhw (in) the land of the Shasu.’ For half a century it has been generally admitted that we have here the tetragrammaton, the name of the Israelite god, ‘Yahweh’; and if this be the case, as it undoubtedly is, the passage constitutes a most precious indication of the whereabouts during the late fifteenth century BC. of an enclave revering this god. And while it would be wrong to jump to the conclusion that ‘Israel’ as known from the period of the Judges or the early monarchy was already in existence in Edom at this time, one cannot help but recall the numerous passages in later Biblical tradition that depict Yahweh ‘coming forth from Se’ir’ and originating in Edom. The only reasonable conclusion is that one major component in the later amalgam that constituted Israel, and the one with whom the worship of Yahweh originated, must be looked for among the Shasu of Edom already at the end of the fifteenth century BC.”²⁴

Redford misuses poetic texts from Deuteronomy 33:2; Judges 5:4; Psalm 68:8; and Habakuk 3:3 (‘numerous passages’) to make his case. But these clearly speak of God’s judgment upon Edom through Israel, prior to the Canaan conquest. Yes, Yahweh “came forth from Seir”, but He did not originate from there. Such verses certainly don’t prove Redford’s ‘reasonable’ case that Yahweh was a minor local Edomite deity!



Figure 7. Soleb temple column 4 with name cartidges (left-most) text: $\text{t}^3 \text{š}^3 \text{sw i-h-w}^3 \text{-}^3$

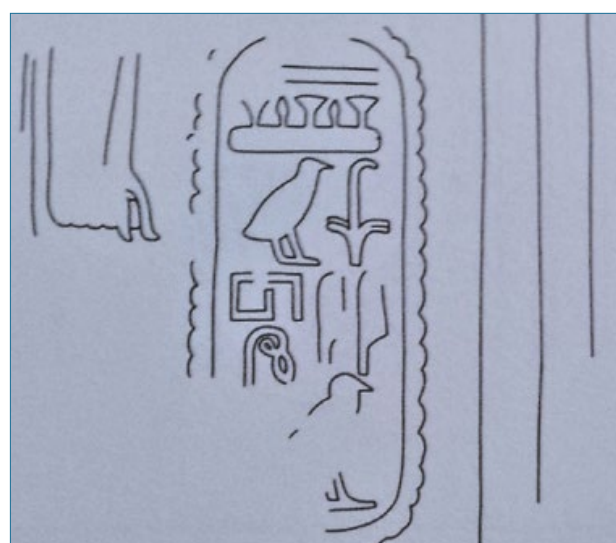


Figure 8. Drawing of Column IV $\text{t}^3 \text{š}^3 \text{sw i-h-w}^3 \text{-}^3$ cartouche. Kennedy disagrees with Giorgini *et al.* that the final symbol does not represent the letter ‘a’, rather a ‘w’.

Date of the inscription

Working with the ‘high chronology’ for Dynasty 18, Kennedy concludes, from inscriptional evidence at Soleb that mentions year 5 of the subjugation of Kush by Amenhotep III:

“... a logical time-frame for the carving of the subjugated lands and peoples recorded at the Soleb temple, which include those in Kush, would be after this campaign of year 5, placing the date of the conquest lists from about 1409–1385 [BC].”²⁵

I agree with Kennedy when he concludes, regarding the identity of the Yahweh nomads:

“Since the only ancient people known to have worshipped a deity named yhw^3 (Yahweh) in ancient times were the Hebrews or Israelites, it also logically follows that these particular $\text{š}^3 \text{sw}$ nomads associated with yhw^3 could be identified with the early Israelites before they became a sedentary population in Canaan,



Figure 9. Princeton Pharaonic Roll 5 (part 1B) showing coloured vignettes and cursive hieroglyphic text (I identified an example of the personal name—ʾadōnī-rōʿē-yāh (the justified—boxed in white)

and that the Egyptians had familiarity with this group and this deity during the 18th dynasty and the end of the 15th century [BC].”¹²

It is only liberal scholars who reject the written historical testimony of the Exodus narrative that refuse to recognize the significance of the Soleb inscription as evidence consistent with the biblical date for the Israelites’ conquest of Canaan.

2) The oldest Yahweh theophoric personal name

Scholars have recently identified the owner of an 18th-Dynasty Book of the Dead (BD) papyrus as possessing the oldest non-Egyptian personal name to include a shortened form of Yahweh (Yah). It represents a theophoric sentence, identifying the owner with the divine name.²⁶ The papyrus is known as the Princeton Pharaonic Roll (PPR5), which resides in the Princeton University Library. The papyrus “probably dates from Dynasty XVIII (1550–1295 BC) and is of unknown provenance.”²⁷ The papyrus is almost 6 m (approximately 20 ft) long and is in four main fragments. The papyrus has around 30 spells from the BD corpus, showing a unique order, and was written in cursive hieroglyphs with coloured vignettes (illustrations) (figure 9).

The papyrus was prefabricated with name spaces left blank, to be personalized by the owner. It is the inserted name of the owner which has caused a stir in the academic world. Egyptologist Barbara Lüscher states:

“... the papyrus owner’s name presents a particular highlight of this manuscript and will attract interest not only among Egyptologists but also in the wider fields of comparative religions and biblical studies.”²⁷

“Regarding the owner’s name, it seems clear that we are dealing with a rare example of a Book of the Dead papyrus for an acculturated foreigner of Semitic (Asiatic) origin.”²⁷

Vignettes in fragment B1 shows the deceased resting in his mummified form, with two birds perched on his chest (falcon and swallow), and what appears to be his Ba standing beside him.²⁸ These are unique references to images from BD spells (76–88).

Regarding the unknown provenance, Lüscher compares similar papyri found at Memphis during the 18th Dynasty. She states:

“The fact that the papyrus owner had a Semitic name would fit well with the multicultural character of Memphis during the early new kingdom and into the landscape of newly discovered tombs and necropoleis of that period in the Saqqara-Memphis area. The large city of Memphis had a comparatively high percentage of foreigners at that time, especially people from Asiatic regions.”²⁷

Analysis of the name




Egyptologist Thomas Schneider was first to analyze and comment on the name, which he proposes is a “Northwest Semitic theophoric sentence name”.²⁹ In Egyptian transcription, Schneider offers: ʾadōnī-rōʿē-yāh, which he translates as: “My lord is the shepherd of Yah”.

“... the present name would be the first documented occurrence [*sic*] of the god Yahweh in his function as a shepherd of Yah, the short form of the tetragrammaton.”²⁹


However, Schneider cites scholars who believe the name Yahweh was a topographical name of a mountain, likely in Edom, meaning something like a ‘rugged windswept mountain peak’. Therefore, the origin of the divine name Yahweh, according to these scholars, was as a local mountain deity. Such theorizing is to be rejected outright. Exodus 3 records the true nature of the divine name and its meaning. This could be why Schneider introduces the possessive ‘of’ for the shepherd Lord, making him possess Yah, as opposed to being called Yah. In which case, unencumbered by philosophical bias, the name could just as easily read: “My lord is the shepherd Yah”. Schneider admits the possibility when he states:


“The first of these elements can most probably be identified with Northwest Semitic ʾadōn ... ‘Lord, master’ with either the possessive suffix pronoun of the 1st p[erson] or the connective -i- (*hireq compaginis*)”²⁹


For the uninitiated, a ‘*hireq compaginis*’ has no substantive meaning in biblical Hebrew. Therefore, a personal name can be spelled in the Bible with or without a *hireq compaginis*. Therefore, there is no change in meaning, because there is no ‘my’ or ‘of’ to drop out.³⁰


The owner’s personal name appears six times within the papyrus, but each time with minor variations. An example is given in figure 9.²⁹ The name ends with the  “seated noble” (A52) determinative. Adjoining, is the A52  “plinth” (Aa11) and  “oar” (P8) which spells: *m3ꜥ-hrw*, meaning “the justified/ true of voice”.


A standardized version can be offered in brief:³¹


 (M17 ‘reed’, A2 ‘seated man with hand to mouth’) <j> equivalent to Hebrew /ʾa/ ‘ayin.


 (X1 ‘bread’, G43 ‘quail chick’) <t-w> equivalent to Hebrew /tu/ or /du/.

 (N35 ‘water ripple’, Z4 ‘two diagonal strokes’) <n-j> equivalent to Hebrew /ni/.



 (D21 ‘mouth’, Z1 ‘stroke’) <r> equivalent to Hebrew /ra/ or /la/.


 (O29 ‘wooden column’) <ʿ> equivalent to Hebrew /ʾa/ ‘ayin.

 (M17, M17 ‘reed’) <y> equivalent to Hebrew /ya/.



 (O4 ‘reed shelter in fields’) <h> equivalent to Hebrew /h/.

The Egyptian transliteration is as follows: *j-t-w-n-j-r-ʿ-y-h*. The Hebrew transliteration of this Egyptian word is reasonably: *ʾadōnī-rōʿē-yāh*. This can be understood as:



ʾadōnī =  (HALOT-130) “my lord/ master”, *rōʿē* =  (HALOT-8880) “shepherd/ to pasture”,


yāh =  (HALOT-3578) “LORD (short form)”.


Combining these words, the name is: “[The] Lord [is] my shepherd Yah”, alternatively: “My Lord [is the] shepherd Yah”.


This 18th-Dynasty theophoric name is highly evocative of the later King David’s Psalm 23:1 “The Lord (YHWH) is my shepherd”   (yhwh [*ʾadōnāy*] *rōʿī*).


Other examples of OT theophoric names from (Late Bronze to Iron Age) Israel help elucidate this name:

ʾadōnī bēzeq (Judges 1:5)   (HALOT-161) “Lord of Bezek”.

ʾadōniyyāh (2 Samuel 3:4, etc.)  (HALOT-162) “Yah is Lord”, or “My Lord is Yah”.

ʾadōnīqām (Ezra 2:13, etc.)  (HALOT-165) “[my] lord has risen [to help]”.

ʾadōnīrām (1 Kings 4:6)  (HALOT-166) “[my] lord is exalted”.

ʾadōnī-šēdeq (Joshua 10:1)  (HALOT-164) “[my] lord is justice/righteous”.

Who was the bearer of the name *ʾadōnī-rōʿē-yāh*?

From a biblical perspective, the answer to this question would likely entail an elite Jew who was buried in Egypt around the time of the Exodus. However, the dating is not certain, from anywhere between the range of 1550–1295 BC. That places the papyrus between 54 years before and up to 151 years after the Exodus (1446 BC). The owner must have been wealthy to afford such a prestigious papyrus for burial. Furthermore, the deceased had a thoroughly Egyptian burial



Figure 10. Folded lead tablet containing a curse and the divine name Yahweh

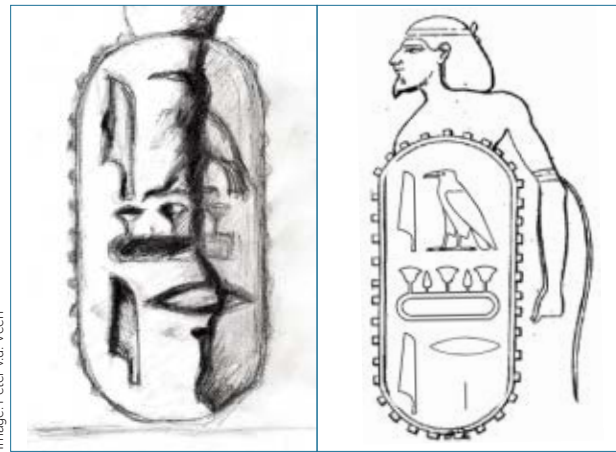


Figure 11. Reconstructions of third name ring on slab ÄM 21687, reading ‘Israel’ alongside complete line drawing

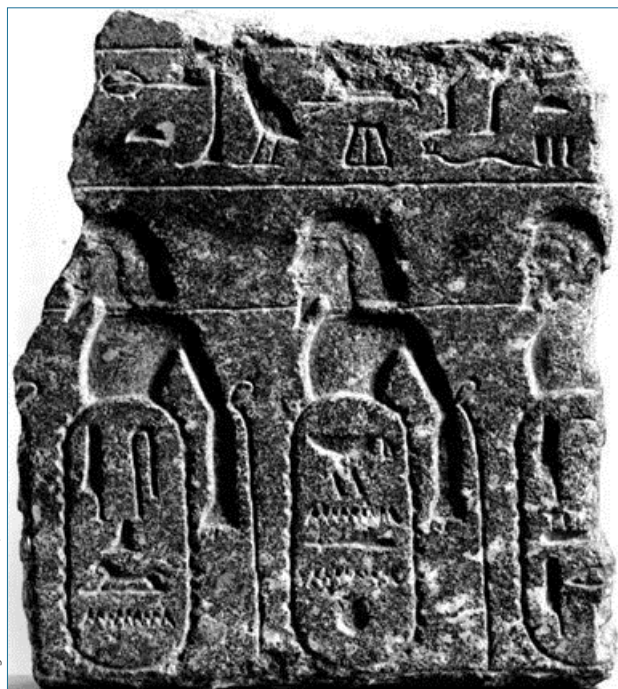


Figure 12. Berlin Statue Pedestal Relief 21687 (c.1425–1350 BC) bearing the toponyms Ashkelon, Caanan, and Israel

scroll, despite having a thoroughly biblical name. Perhaps he was an elite, Exodus-era Jew, but until such a time as more information becomes available, we can only speculate.




3) The oldest Hebrew Yahweh inscription





As I have discussed previously in JoC,³³ associates for Biblical Research announced the discovery of the oldest proto-Hebrew inscription bearing the name Yahweh³² from Mount Ebal, site of the covenant renewal ceremony between Joshua, Israel, and Yahweh. The inscription forms a curse, inscribed on a folded, lead tablet (figure 10). Scripture records that, just after Israel entered the Promised Land, blessings and curses were pronounced from two mountains—Gerizim (blessings) and Ebal (curses).³⁴ On Mount Ebal, Joshua built an altar³⁵ and renewed the Covenant (Joshua 8:30).

A sample of lead from the tablet was sent off for analysis, which determined the metal came from Greek mines dated between 1400–1200 BC. This date is consistent with the early Exodus date (1446 BC) plus 40 years of wilderness wandering. The first year of Israel's Canaanite conquest was therefore 1406 BC, according to the Masoretic chronology, and equivalent to the Late Bronze II period (LBII).

4) The oldest 'Israel' inscription—the Berlin Pedestal

Only after Israel had conquered Canaan and became established would it be considered a nation by its immediate

neighbours. The earliest mention of Israel fits the biblical chronology and narrative tightly, and such an inscription comes from Egypt. Egyptologist Manfred Görg (2001, 2011) first proposed to read the name 'Israel' on a broken Egyptian inscription ÄM 21687 (tentatively dated between 18th–19th dynasties, see below) currently in storage at the New Museum in Berlin, but of unknown provenance. Biblical archaeologists Peter van der Veen and Egyptologist Christopher Theis have subsequently confirmed Görg's reading.³⁶ The inscription is on a fragment of broken granite 46 cm × 39.5 cm (18 in × 15.5 in) from a statue pedestal which is very similar to pedestal relief ÄM 21688. Both pedestals show name rings with bound prisoners. ÄM 21687 has two recognizable names:  *i-s-k-l-n* "Ashkelon", and  *k-y-n-c-n-nw* "Canaan". Both these names are well attested in these forms, previously under Thutmose III and Amenhotep II during the 18th Dynasty (but without the mention of Israel). The rightmost name on the later ÄM 2187, which was likely damaged in modern times, reads:  *i-[-?]šš-i-r* (figure 11).

The missing sign has been confirmed to be an alef (ʾ) vulture symbol  [G1], where  is the short form of the divine name 'El, itself attested in this form in the early 18th Dynasty. It has been claimed the Egyptian š poses a textual difficulty, nevertheless, š was known to represent West Semitic ś during this time period.³⁶ That Canaan, Ashkelon, and Israel appear together fits the topographic order found on the later Merenptah 'Israel Stele' (dated to the king's 5th year, c. 1213–1203 BC) (figures 13, 14). Here, Israel is spelled  *y-s-r-i-r* (with accompanying 'foreign peoples' determinatives) and should be placed in the time of the Judges.³⁷ The combined evidence is that the name *i-[-?]šš-i-r* , inscribed on ÄM 21687, most likely represents an archaic form of Israel, which predates Merenptah's Stele and represents a pre-Judges period mention of Israel.³⁶

Dating ÄM 21687 (the Berlin Pedestal)

V.d. Veen and Theis tentatively date the Berlin inscription to the 19th Dynasty under Ramesses II, who was the father of Merenptah (who later also mentions Israel on his stele). However, Görg dated it to Amenhotep II's reign (1427–1401/1397 BC) due to the archaic renderings of 'Ashkelon', 'Canaan', and the divine name 'El. All these words deviate from their forms known from the later 19th and 20th Dynasties. V.d. Veen has also suggested a somewhat earlier date based on the shorter name rendering:³⁸

"... if the names had been copied from an earlier source (supported by the archaic orthography of all three names on the slab), this would indeed suggest that Proto-Israelites had migrated to Canaan sometime nearer the middle of the second millennium [BC]."³⁶



Figure 13. Merenptah 'Israel Stele' JE 31408, Cairo Museum



Figure 14. Merneptah Stele replica with enhanced text of 'Israel', spelled y-s-r-i-r, located at King Merneptah's funerary chapel, Thebes

Summary

Table 1 summarizes the four inscriptions and their dates in relation to the traditional Exodus date of 1446 BC.

Conclusion

The traditional 1446 BC Exodus date can be calculated from biblical chronological data, is corroborated by extrabiblical Jewish calendrical information, as well as Babylonian and Egyptian synchronisms. Four corroborating inscriptions have been discussed; specifically, the following:

1. A Soleb Amun temple column name ring, identifies pre-Canaan-conquest Israel with their national God, Yahweh, identifying them as non-settled 'nomads'. Such would be the case when Israel had left Egypt and were either wandering or in the process of conquering Canaan under Joshua.
2. A Book of the Dead papyrus (PPR5) bears a theophoric name containing Yahweh ("The Lord is my Shepherd Yah") which likely meant the scroll was buried with an elite Jew, around the time of the Exodus.
3. A lead curse-tablet, dating to between 1400–1200 BC from Mount Ebal, Israel, bears a curse and the divine name Yahweh, representing the earliest known Paleo-Hebrew inscription. This is consistent with Joshua's covenant renewal ceremony (Joshua 8:30).
4. Finally, a granite pedestal inscription, Berlin ÄM 21687 (dated between 18–19th dynasties, predating Merenptah's 'Israel Stele', 4a) bears the earliest known Egyptian reference to 'Israel' as a national identity, consistent with early Israel just after Joshua's conquests.

The four evidences discussed here strongly support the biblical narrative of Israel's Exodus, wandering period, and Canaan conquest under Joshua, post 1446 BC. The biblical record is thus corroborated by the existing archaeological evidence. The late Exodus date of c. 1290 BC under Rameses II cannot be maintained in the face of this combined evidence.

Table 1. Summary of three Yahweh and earliest Israel inscriptions, consistent with 1446 BC Exodus date

No.	Identity	Location	Description	Date	Comment
1	Soleb name ring	Soleb, Amun temple, Sudan	Column 4 name ring	Amenhotep III (c. 1387–1348 BC)	'Nomads of Yahweh', Egyptian description of nomadic, pre-Canaan conquest Israel.
2	Book of the Dead papyrus PPR5	Saqqara	Book of the Dead papyrus roll	18 th Dynasty (1550–1295 BC)	Egyptian burial scroll with Yahweh theophoric personal name, likely belonging to an elite Jew.
3	Ebal curse tablet	Mount Ebal, Israel	Lead curse tablet	1400–1200 BC	Curse text inscribed on lead with 'Yahweh' consistent with Joshua's covenant renewal ceremony.
4	Berlin ÄM 21687 inscription	Uncertain provenance	Partial name ring on granite statue pedestal relief	18 th Dynasty (possibly to Amenhotep II, 1427–1401 BC)	Archaic form of Israel, first Egyptian inscription of new state of Israel (pre-Judges period).
4a	JE 31408	Thebes	Granite stele	5 th year of Merenptah (1213–1203 BC)	Pharaoh Merenptah boasts of destroying Israel (Judges period).

Furthermore, the promise to Israel, that Yahweh's name would be known to all generations (Exodus 3:13) is demonstrated to be true from the inscriptional evidence.

Acknowledgement

I would like to thank Gary Bates for commenting on an earlier draft, and for the anonymous reviewers for their critical remarks.

References

1. It is unclear exactly how 'Yahweh' was pronounced, as the vowels were not pointed by the Masoretic scribes.
2. *Brown Driver Briggs Hebrew Lexicon* (entry 582) explains: "most [scholars] take it as Qal of *hwh* (= *hyh*); the one who is: i.e. the absolute and unchangeable one; the existing, ever living, as self-consistent and unchangeable, or the one ever coming into manifestation as the God of redemption."
3. Mark, J.J., Egyptian gods—the complete list, 14 Apr 2016; worldhistory.org.
4. Petrovich, D., Amenhotep II and the historicity of the Exodus Pharaoh, biblearchaeology.org, 4 Feb 2010. Rodger Young is a British biblical chronologist and Edwin Thiele (10 Sep 1895–15 Apr 1986) was an American-born Old Testament professor.
5. See the useful discussion in Thomas, B., Two date range options for Noah's Flood, *J. Creation* 31(1) 2017; creation.com/images/pdfs/tj/j31_1/J31_1_120-127.pdf.
6. See also Bates, G., Egyptian chronology and the Bible—framing the issues, creation.com/egypt-chronology, 2 Sep 2014.
7. Although the 50th year was consecrated, Young shows, from multiple ancient Jewish sources, that it was the 49th year that was calendrically counted.
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10. britishmuseum.org/collection/object/W_1896-0409-51, accessed 11 Aug 2022.
11. Freedman D.N., The Babylonian Chronicle, *The Biblical Archaeologist* 19(3):49–60, 1956.
12. Lepsius, C.R., *Denkmäler aus Aegypten und Aethiopien*, vols. 2, 5, 6, Nicolaische Buchhandlung, Berlin, 1849–1859.
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15. Titus, K., The Land of the š3sw (Nomads) of yhw3 at Soleb, *Dotawo, A J. Nubian Studies* 6(1):175–192, 2019.
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17. More recently archaeologist Joel Kramer has brought the Soleb Yahweh inscription to a popular audience, in his online presentations, including an interview with Associates for Biblical Research; for example, see: Associates for Biblical Research, The Oldest Yahweh Inscription: Digging for Truth Episode 49, 7 Apr 2019, youtu.be/yXlo5Cp7_jc. It is also mentioned in: Anderson C. and Edwards, B., *Evidence for the Bible*, DayOne, China, p. 18, 2018; digitalresources.creation.com/product_samples/pdf/10-2-704.pdf.
18. Also discussed in Billington, C.E., The name Yahweh in Egyptian hieroglyphic texts, biblearchaeology.org, 8 Mar 2010.
19. Square brackets with numbers [#] refer to Gardiner's sign numbers, followed by Gardiner's 'translation', followed by Egyptian Wörterbuch Lexicon entry number shown in round brackets (#).
20. Kennedy identifies the terminal bird sign as an aleph G1, as opposed to the usual understanding of the 'w' vowel G43.
21. Giveon, R., Toponymes ouest-asiatiques à Soleb, *Vetus Testamentum* 14(3):239–255, 1964.
22. The documentary hypothesis, involving at least four anonymous (hypothetical) editors, labelled 'JEDP' has come under fatal academic attack, see: Holding, P.H., Debunking the Documentary Hypothesis, *J. Creation* 19(3):37–40, 2005; creation.com/debunking-the-documentary-hypothesis.
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25. Kennedy is using the "high chronology for Dynasty 18". Dates for the NK onwards are fairly secure, and cannot be adjusted in radical ways as New Chronologists such as David Rohl suggest.
26. Cf. Exodus 17:16; Song 8:6; Psalm 77:12; 118:5, 17; 122:4.
27. Lüscher, B., Princeton Pharaonic Roll 5: an ancient Egyptian Book of the Dead for an Asiatic, *The Princeton University Library Chronicle* 71(3):458–460, 2010.
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33. Cox, G., The most ancient Proto-Hebrew inscription ever discovered! *J. Creation* 36(2):14–15, 2022.
34. Cf. Deuteronomy 11:27, 29 and Joshua 8:30.
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38. The earliest reference to Israel and its possible archaeological and historical background, Zwickel W. and van der Veen, P., *Vetus Testamentum* 67:129–140, 2017; p. 131.

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Word use patterns in Genesis 1: evidence against the Framework hypothesis

Shaun Doyle

A crucial feature of the Framework interpretation is that the putative ‘two triads of days’ pattern supports the non-historicity of the Genesis 1 ‘days’. However, the word use patterns of טוֹב (*tôb*: good) and בָּרָא (*bārā*: create) throughout Genesis 1 undermine the primacy of this ‘two triads’ pattern. Instead, they provide powerful evidence that the narrative flow of Genesis 1 is governed by the sequential progression of the six days of work followed by one day of rest.

The Framework Hypothesis posits that the structure of Genesis 1 is evidence that its depiction of God’s creative work is non-historical:

“The Framework Interpretation of Genesis 1:1 through 2:3 is the view which maintains that, while the six days of creation are normal solar days, the total picture of God’s completing His creative work in a week of days is not to be taken literally, but functions as a literary framework for the creation narrative; and that the eight creative historical works of God have been arranged according to other than strictly sequential considerations, and that where there is sequential order it must be determined by factors other than the order of narration alone.”¹

The major literary structure in Genesis 1 that it cites as evidence is that the main elements made on the first three days of Creation Week correspond with main elements in the second three days of Creation Week (table 1), termed the ‘two triads’ pattern by Framework proponent Meredith Kline.² For instance:

- light and darkness on Day 1 correspond to the celestial lights on Day 4
- waters above and below on Day 2 correspond to flying and swimming creatures on Day 5
- land and vegetation on Day 3 correspond to animals and humans on Day 6.

Framework proponents argue that this schema reflects a recapitulation of Days 1–3 on Days 4–6, which serves as the fundamental literary structure governing the meaning of Genesis 1.^{2,4} However, this indicates that the stated *sequential* 6-day schema of Genesis 1 was conformed to this more fundamental non-historical literary structure of the narrative. They argue that this supports a non-historical reading of the Genesis days.

In response, many have pointed out that there are difficulties for the ‘tightness’ of the correspondences.^{3–7} Nonetheless, such considerations are unlikely to persuade Framework proponents, since, even with those exceptions, the general ‘two triads of days’ pattern is still discernible. While the celestial lights on Day 4 were placed in the ‘expanse’ (*rāqîa’*), which was made on Day 2, their stated function in Genesis 1:18 links

them explicitly to Day 1. While the birds on Day 5 breed on the ‘earth’, which was made on Day 3, and the seas were not *named* until Day 3, the categorization of the animals made on Day 5 (water and sky animals) is a one-to-one correspondence with the elements first distinguished on Day 2. The text does seem to make substantive thematic links between Days 1/4, 2/5, and 3/6 respectively.

However, this pattern is of minor consequence by itself. God could have adapted His *works* in Genesis 1 to fit such a pattern as easily as Moses could have adapted his *words* to depict such a pattern. After all, Genesis 1 depicts God creating the world *supernaturally*. As such, there is nothing particularly *surprising* about such a structure for a *week-long supernatural event* that favours a thematic rather than lineal reading of the text’s depiction of God’s activities. So, the thematic pattern does not suffice to establish a non-historical reading by itself.

To make the case either way, we need to understand something of the *nature* of the correspondences. Is there anything that would make us think the text is non-historical? Framework proponent Meredith Kline cites the nature of the parallels of Days 1 and 4:

“Temporal Recapitulation. The non-sequential nature of the creation narrative, and thus the non-literal nature of the creation ‘week’, is evident from the recording of the institution of lower register time in both the first and fourth day-sections. ...

“The forming and stationing of the sun, moon, and stars are attributed to day four. Their functions with respect to the earth are also stated here, first in the fiat section (Gen. 1:14, 15) and again (in reverse order) in the fulfillment section (Gen. 1:16–18). They are to give light on the earth and to rule by bounding light/day and darkness/night, as well as by demarcating the passage of years and succession of seasons. These effects which are said to result from the production and positioning of the luminaries on day four are the same effects that are already attributed to the creative activity of day one (Gen. 1:3–5). There too daylight is produced on the earth and the cycle of light/day and darkness/night is established. In terms of chronology,

Table 1. Framework schema of the Genesis 1 days, as per Arnold³

Form	
Day	Object created
1	One work: light
2	One work: sea and expanse
3	Two works: earth and vegetation

Fullness	
Day	Object created
4	One work: luminaries
5	One work: birds, fish
6	Two works: land animals and humans

day four thus brings us back to where we were in day one, and in fact takes us behind the effects described there to the astral apparatus that accounts for them. The literary sequence is then not the same as the temporal sequence of events.”²

Kline argues that Day 1 and Day 4 describe the *same* event in different ways; Day 4 gives more detail than Day 1. So, if Day 1 and Day 4 refer to the *same* event, they clearly cannot be separated by three days with the creation of the whole cosmic structure and vegetation in between. As such, ‘Days’ 1 and 4 are non-historical. This is extrapolated to the other correspondent days by way of the ‘two triads’ pattern to infer that the Genesis ‘days’ are not a literal/historical sequence of events, but a topical framework of patterns that uses a six-day sequence as an ancillary literary device.⁸

Seen in this way, it shows that the divergences from the ‘two triads’ pattern are not as significant evidence against it as first may be thought. After all, if Kline is right about the *nature* of the correspondence between Day 1 and Day 4, a non-historical view of the Genesis 1 days plausibly follows *even though* the correspondences are not all exact and precise. Indeed, it may even be expected, given that the 6 + 1 day ‘work week’ sequential schema in Genesis 1 overlies the topical ‘two triads’ pattern. So long as the ‘two triads’ pattern is easy enough to discern, such ‘imprecision’ fails to provide a probative undercutting defeater for a non-historical reading.

But is Kline right about Day 4 *replaying* Day 1? I think Kline is right that a ‘two triads of days’ pattern is discernible in Genesis 1. However, he has ignored others that fatally undermine his ‘replay’ thesis. Specifically, the use of the words ‘good’ (*tôb*) and ‘create’ (*bārā*) in Genesis 1.

‘Good’ and the completion of God’s works in Genesis 1

The word ‘good’ is used seven times in Genesis 1 (Genesis 1:4, 10, 12, 18, 21, 25, 31). In every case, it coincides with the completion of some aspect of creation:

- light (v. 4)
- cosmology—heaven, earth, and seas (v. 10)
- vegetation (v. 12)
- day and night/separation of light and darkness (v. 18)
- sea and sky creatures (v. 21)
- land animals (v. 25)
- humanity/everything (v. 31; ‘very good’).

Concerning the first use of ‘good’ in Genesis 1:4, its precise placement is significant:

“And God said, ‘Let there be light,’ and there was light. And God saw that the light was *good*. And God separated the light from the darkness [emphasis added].”

It is placed *before* God splits the light and darkness (figure 1). So, God does not call the split between day and night ‘good’ in v. 4, but only the *light* He made in verse 3.⁹ This is significant, in that (*contra* Arnold; figure 1) it divides Day 1 into *two* works—the creation of light, and the separation of light and darkness. Now, God does call the split between light and dark ‘good’, *but not on Day 1*. Rather, He calls it ‘good’ on Day 4 in vv. 16–18:

“And God made the two great lights—the greater light to rule the day and the lesser light to rule the night—and the stars. And God set them in the expanse of the heavens to give light on the earth, to rule over the day and over the night, *and to separate the light from the darkness*. And God saw that it was *good* [emphases added].”

Moreover, the separation of light and darkness is not mentioned at any point between vv. 4–5 and vv. 16–18. Instead, God engages in two other ‘good’ works—the creation of the basic cosmic ‘sky/sea/land’ structure and the creation of vegetation. As such, it appears God began the work of ‘separating light and darkness’ on Day 1, left it on hiatus during Days 2–3, and resumed it and completed it on Day 4 (as per the association of ‘good’ with the separation of light and dark in v. 18).

But why would there be such a hiatus? God intended for the celestial lights to govern the day and night (as mentioned several times in vv. 14–18). But where to put them? They were put “in the expanse”. However, the expanse didn’t exist on Day 1; it was created on Day 2. Therefore, the expanse had to have been created before the celestial lights could be put in it.

But how could there be day and night before God made the celestial objects? Precisely the way vv. 4–5 describes:

“... and he separated the light from the darkness.

God called the light ‘day’, and the darkness he called ‘night’.”

When God separated the light and darkness, He called the light ‘day’ and the darkness ‘night’. Day and night were thus established, which was sufficient to mark the passing of consecutive day–night cycles until such time as God put the lights in the sky to govern day and night. This comports with

v. 5, using the cardinal ‘one day’ rather than the ordinal ‘first day’; the separation of light and dark on Day 1 was enough to *constitute* a day–night cycle, and thus ‘one day’. However, the lack of the word ‘good’ for the separation of light and darkness in v. 5 signifies that, while the work done on Day 1 was sufficient to constitute a day–night cycle, the ‘good’ work of separating light and darkness was not *complete* until the lights that govern day and night were in the sky.

And while the separation of light and darkness is the only ‘good’ work within Genesis 1 that seems to have been put on hiatus, it is not the only time a creative work spans more than one day in Genesis 1. The formation of the cosmic structure begins on Day 2 and finishes on Day 3. God split the waters above and below on Day 2 (Genesis 1:6–8) but does not call it good. He does not call *anything* good on Day 2. But God begins Day 3 by bringing the land out of the sea (Genesis 1:9–10). It’s only once the heavens, earth, and sea are all established that He calls the work ‘good’ (Genesis 1:10).

But God calls a second work ‘good’ on Day 3: vegetation (Genesis 1:12). So, like Day 1, Day 3 includes *two* works. Days 4–6 do not replicate this pattern. As we have seen, no work is called ‘good’ on Day 2, but two works are called ‘good’ on Day 3 (vv. 10, 12). This pattern is not repeated in the second three days either. Like Day 3, ‘good’ is used twice on Day 6 (vv. 25, 31), but ‘good’ is used once on Day 5 (v. 21), while not being used at all on Day 2.

These factors indicate how the word ‘good’ functions in Genesis 1—it’s a word denoting appreciation of the *completion* of a creative work. Gentry agrees: “the appreciation formula [‘it was good’] follows the *completed* divine activity”.¹⁰ This is most obvious in Genesis 1:31: “And God saw everything that he had made, and behold, it was very good.” Once *everything was finished*, He called it ‘very good’. Indeed, this is the seventh use of ‘good’ in Genesis 1, and the only time it is intensified with ‘very’. It is also supported in Genesis 2 (arguing for the literary unity of Genesis 1 and 2), as Gentry elaborates:

“Although the creation of man as male and female is ‘good’—actually ‘very good’ (Gen. 1:31)—this was not originally so. Genesis 2 informs us that at the moment when God first created Adam it was ‘*not good*’ for the man to be alone’ (Gen. 2:18, emphasis added). How does He correct this deficiency so that He may indeed declare man’s creation ‘good’? He *separates* woman out of the man (Gen. 2:21–22). *Then* once they both exist, He declares the final result ‘good’ (Gen. 1:27, 31). The creation of man is not complete, is not ‘good’, i.e., it is not what God wants as a final result *until* Eve is separated out of Adam later on day 6.”¹¹

These factors inform the other uses of ‘good’ in Genesis 1. Once God *finished* the light, He called it ‘good’ in the *middle* of Day 1 rather than the end. God started the cosmic structure on Day 2, but only finished it on Day 3, which explains why nothing was called ‘good’ on Day 2. And so, God began the separation of light and dark on Day 1 *and finished it* on Day 4. Only once the work was finished did He call it ‘good’. This,

however, refutes Kline’s contention that Day 4 *recapitulates* Day 1. Day 1 has *two* works on it, whereas Day 4 merely *completes* the *second* work God began on Day 1. Moreover, the ‘light’ God made on Day 1 is a separate ‘good’ work from the ‘lights’ God made on Day 4, which was a part of His ‘separation of light and dark’ work. Day 4 is not identical to Day 1.

‘Create’ and the thematic hinge of Genesis 1—Day 3 or Day 4?

What about the ‘two triads’ pattern? Do the correspondences still provide evidence that the event sequence should be read literarily rather than historically? No. First, the first ‘triad’ ends on Day 3. However, the use of ‘good’ in Genesis 1 shows that making the end of Day 3 the thematic hinge of the narrative fails because a work begun during Days 1–3 has not been completed by the end of Day 3: the separation of day and night. God had made a *fundamental* separation between them on Day 1, but had not yet *finished* the setup He was putting in place to demarcate day from night. Thus, Day 4 should not be separated from Days 1–3.

This comports with the pattern of use for ‘create’ (*bārā*) in Genesis 1. It is used five times for three different events: in Genesis 1: ‘the heavens and the earth’ in v. 1, the first ‘living creatures’ (נֶפֶשׁ חַיָּה *nēpēš ḥāyyāh*) in v. 21 (beginning Day 5—figure 2), and humanity in v. 27 (three times; ending Day 6). The time placement of those is significant: each time God began creating something *new*. Significantly, neither the vegetation on Day 3 nor the stars on Day 4 were called ‘living creatures’. This indicates Days 1–4 was all one class of thing God ‘created’—the cosmic ‘stage’ in which the ‘living creatures’ would live. The living creatures were another. We were another. Thus, both word use and the logistical structure



Figure 1. Michelangelo’s “Separation of Light from Darkness” from the ceiling of the Sistine Chapel. God’s work of dividing the light and darkness was itself divided into two days: Day 1 and Day 4 of Creation Week.

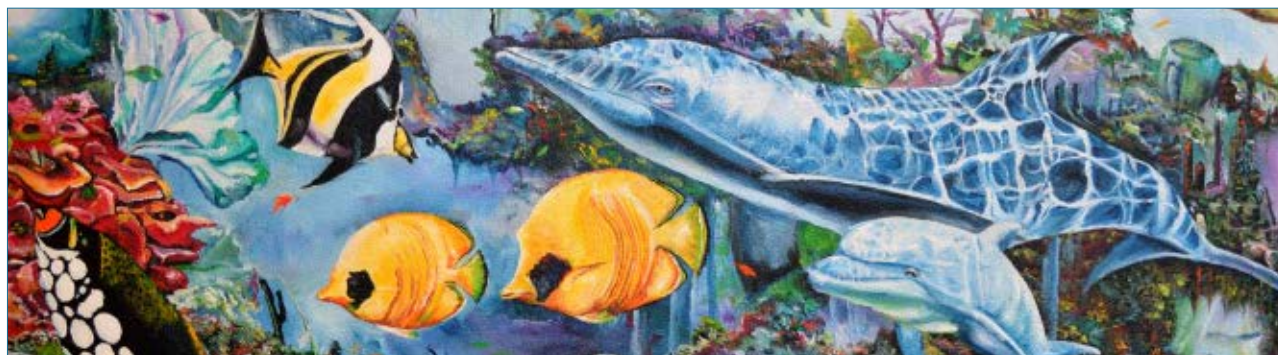


Image: paulbr75, Pixabay / CCO

Figure 2. The word *bārā* suggests the narrative hinge of Genesis 1 exists between Days 4 and 5. The first time *bārā* is used for a specific class of object in Genesis 1 is for the first 'living creatures' God made, the sea creatures.

in the event sequence of Genesis 1 create a hinge at the end of Day 4 rather than Day 3.

Does this mean the 'two triads' pattern is *not* present in Genesis 1? Perhaps, but not necessarily. There is no problem with multiple divergent patterns existing in a text like Genesis 1. Indeed, it is suffused with literary devices and patterns. This makes Genesis 1 one of the most memorable pieces of literature in Scripture—even in translation, which is an impressive literary feat. However, the text's focus on hinging the narrative flow at the end of Day 4 rather than Day 3 suggests that, if the 'two triads' pattern is real, it *does not govern the narrative flow of Genesis 1*. Indeed, the structure of God's seven 'good' works and the three classes of things He 'created' is asymmetrical and quite *ad hoc*. God spans one 'good' work over 1.5 days, and another He leaves unfinished at the end of a day only to pick it up again *three days later*. This is highly unexpected if some symmetrical literary structure in Genesis 1 governed its narrative flow in a way that relativized the stated chronology. But if the stated '6 + 1 day' chronology governs the narrative flow of Genesis 1, this is unsurprising. Work conducted through a week often has precisely the sort of *ad hocness* and asymmetry we see in the progression of God's 'good' works through Genesis 1.

Conclusion

The pattern of 'two triads of days' employed by framework theorists may or may not be a genuine literary pattern in Genesis 1. However, it fails as an argument for the non-historicity of the Genesis 1 'days'. The arrangement of God's seven 'good' works and the three classes of thing God 'created' undermines the idea that Day 4 recapitulates Day 1, *in toto*, and the idea that the end of Day 3 is the primary thematic hinge of the narrative. Rather, the asymmetrical and *ad hoc* arrangement of these factors is strong evidence that the narrative flow of Genesis 1 is governed primarily by its stated seven-day chronology.¹² Genesis 1:1–2:3 is *primarily* a narrative that progresses sequentially from start to finish through a seven-day timespan. Whatever the function of the 'two triads' pattern, it does not relativize the stated seven-day

chronology of Genesis 1 in a way that evinces non-historicity in that chronology.

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12. However, while I affirm that Genesis 1 refers to a literal-historical week, the fact that the narrative flow is governed by its sequential chronology does not necessarily imply that Genesis 1 is a literal-historical narrative. The *historicity* of the narrative must be established on independent grounds. For instance, I think God's assertion of six-day creation in Exodus 20:11 provides sufficient independent ground to believe Genesis 1 refers to a historical week.

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How Darwin was the basis of *Lebensraum*

Jerry Bergman

The concept of *Lebensraum* was based on the idea that superior people have a moral obligation to take the land of inferior people. This belief, largely inspired by Charles Darwin, was a central factor in causing WWII. Three people—Friedrich Ratzel, Karl Haushofer, and Rudolf Hess—were instrumental in developing the concept of *Lebensraum* in Germany and influencing its implementation into Nazi policy. The end result was World War II, which, in addition to taking the lives of between 40 and 50 million people, was the most expensive war in history.¹ Ratzel, Haushofer, and Hess were all openly followers of Darwin. They accepted his worldview and implemented it into German Nazi policy. Both Haushofer and Hess helped Hitler write *Mein Kampf* when Hitler was serving his prison term at Landsberg prison after their failed ‘beer-hall putsch’. *Mein Kampf*, in turn, was the Nazi Bible that outlined Nazi policy.

Lebensraum, German for ‘living space’ or ‘room to live’, was the belief that a nation’s territorial expansion was essential to the survival of its people. The concept of *Lebensraum* was “a critical component in the Nazi worldview that drove both its military conquests and racial policy.”² The invasion of Poland, which formally began WWII, was the result of a direct application of this belief. The *Lebensraum*-inspired invasion of the Soviet Union, called Operation Barbarossa, began on Sunday, 22 June 1941.

Lebensraum had its origin in the field of geography because this concept deals with land use, national territory, and the influence of land on culture. An example of the areas studied in the field of geography is urban versus rural land use in addition to ethnic population and geographic cultural differences. Darwinian evolutionary beliefs widely influenced 19th-century German thought, particularly the work of the renowned University of Munich professor, geographer, and ethnographer Friedrich Ratzel (1844–1904; figure 1) and his formulation of the *Lebensraum* concept.³

The Darwin-Haeckel connection

Ratzel’s background was in zoology, and in 1869, he published a book written to educate the common people about Darwinism, titled *Being and Becoming*.⁴ He was influenced by the evolutionary theories of both Darwin and those of one of his professors, German zoologist and Darwinist Ernst Haeckel.⁵ Ratzel’s writings displayed an “uncritical acceptance of Darwin’s main concepts and an obvious reliance on the views of Haeckel.”⁶ Haeckel was a leading German evolutionist and a best-selling author who was central in spreading the acceptance of Darwinism into both German academia and among the common people.⁷ As Lund University professor Christian Abramsson wrote:

“... the key event influencing and to some degree shaping German geographical thought during the second half of the 19th century was the publication of Charles Darwin’s *On the Origin of Species by Means of Natural*

Selection, or the Preservation of Favoured Races in the Struggle for Life. Of particular interest here is the fact that *The Origin of Species* appeared in German translation in 1860, just months after the original book was published (see Gliboff, 2008). The publication of *The Origin of Species* didn’t go unnoticed by the younger generation of German geographers at the time. Oscar Peschel, Ratzel’s predecessor at the chair of geography in Leipzig, began promoting Darwinian ideas immediately after *Origin of Species* appeared, most noticeably in a review in the journal for which he was the editor at the time, *Das Ausland* [Foreign Countries]. Here Peschel develops the [concept of] ... *Lebensraum* in order to translate Darwin’s hypothesis into geographical terms. For Peschel the notion of *Lebensraum* drew attention to the fact that, according to him, natural selection was already a telluric selection (Peschel, 1860). ... the reception of Darwinian thought into the German sphere was widely divergent.”⁸

Another “equally important, dividing line concerning the reception of Darwinism was that between monogenism—positing a common ancestry of man—and polygenism—positing that the races of man are of different lineages.”⁸ Evolutionary theory in German thought led to the widespread rejection of Christian monogenism and the widespread acceptance of polygenism. Conditions that led to the rapid acceptance of Darwinism and its translation into geographical and political thought include

“... the reception of Darwin [which] must be understood in relation to the nascent national project of the second Reich, which saw Germany as being left behind in the colonial race. The colonial project was simultaneously conceived as answering to economical and demographical challenges (Smith, 1986). The demographic question, or the question of overpopulation, was ... a specific concern in the formation of German colonial politics. A recurring argument was that Germany needed to establish colonies to create space for its growing



Figure 1. Professor Friedrich Ratzel, whose ideas on *Lebensraum* were adopted by Hitler

population. In this context the emphasis that Darwinian thought put on change and evolution could serve as a scientific explanation and rationale for the need for colonial expansion—a project in which the leading geographers in Germany eagerly participated (Bassin, 1987; Danielsson, 2008; Smith, 1986). A political and social interpretation of Darwinian evolutionary thought could also provide a scientific rationale for the subjugation and extermination of indigenous populations (Weikart, 2003; Danielsson, 2009).⁹

Ratzel believed that, in order to appropriately protect itself from external threats, a nation must be self-sufficient both in its resources and territory.¹⁰ Nazi leader Adolf Hitler openly used the *Lebensraum* idea to justify his invasion of Poland, and later Russia.¹¹ As written in the U.S. Holocaust Museum's *Encyclopedia of the Holocaust*:

“Friedrich Ratzel and others were also deeply influenced by the new work of Charles Darwin and his theory of natural selection. ... contending that, like the species Darwin studied, nations too struggled over resources for survival where only the fittest would win. Ratzel argued ... that a society who effectively adapted to one geographic territory would logically expand the borders of their country into other [*sic*] territory. Pointing to the British and French Empires and to American ‘Manifest Destiny’, Ratzel contended that Germany required overseas colonies to relieve German overpopulation. The East presented another logical outlet for growth. ... Naturally, the inferior races that occupied this region must be removed, both Slavs and Jews.”¹²

Tragedy unleashed

Furthermore, “scientific racism based on social Darwinism radicalized racism in the 19th and early 20th centuries by providing a scientific rationale for exterminating non-European races.”¹³ Even Ratzel “often used the terms ‘higher’ and ‘lower’ to refer to different groups of people” and presented “Europeans as biological superior, the non-Europeans as

biological inferior.”¹⁴ Furthermore, *Lebensraum* was an example of the inevitable Darwinian struggle between human groups, and the ‘biologically superior’ group was destined to prevail.

Ratzel was also influenced towards Darwinism by his close friend, University of Munich zoology professor Moritz Wagner. Wagner was an active Darwinian who, in 1868, published a book written “to put Darwin’s theories in their proper geographical context.”¹⁵ Wagner stressed that a natural drive of human life was migration and colonization, which inevitably produced territorial conflicts. Darwinism taught that in the end the superior people would prevail over the inferior nations. The belief is stated as, “like a plant, a *Volk* had to grow and expand its *Lebensraum* or die.”¹⁶

It was from Friedrich Ratzel that Hitler adopted the notion of space or territory (*Raum*) and he used the war to carry out this goal. The justification soon became *Lebensraum*, based on Ratzel’s goals, who sought

“... to develop political geography into a discipline designed to trace man’s evolution over time as it related to his physical geography. The state, ‘part man and part soil’, was basically a ‘form of the distribution of life on the earth’s surface.’ For Ratzel, Charles Darwin’s ‘struggle for survival’ came down to a simple ‘struggle for space’. Or, as he once put it, ‘bio-geography’. Under [Karl] Haushofer’s tutelage, Hess and Hitler read Ratzel’s *Political Geography*. And they did so ‘with the sacred fire of passion.’”¹⁷

“That Ratzel was heavily influenced by Darwin’s theories of natural selection and evolution is clear. In 1869, for example, he published a general description of Darwin’s theory of natural selection written for lay readers.”¹⁸

In the early 1900s German beliefs about

“... human life and societies were being transformed by Darwinism and social Darwinism—i.e. that life was a constant struggle and that international relations was a never-ending struggle for survival by national political entities (nations) in which morality and justice were not too important in comparison with the need to muster greater power and resources than one’s rivals.”¹⁹

Furthermore, science, including Darwinism, “was held in high regard (it was even replacing religion as the entity to which many people looked for understanding and for guidance).”¹⁹ The result was that both humans and the societies they created were now studied by scientific methods that would be used to

“... produce ‘laws’; the laws would not only provide knowledge but also provide applications. Like technology, these applications would provide advantages to those nations that defined them and put them to use. The impact of Darwin’s theories on all the emerging social sciences was profound. This is especially true of geography, one of the new social sciences that was being created ...”²⁰

Ratzel convincingly argued that entire nations, such as Germany, were basically biological

“... organisms and as such were subject to the same Darwinist pressures, requirements etc. as other living organisms. This model carried many ramifications: nations were born, grew and matured; nations could also die. As with all organisms, nations require land, space, in order to survive.”²¹

Karl Haushofer was a WWI German general who later became an academic specializing in political and geographical science. Through Haushofer’s student, Rudolf Hess, Haushofer’s ideas of *Geopolitik* (which included *Lebensraum*) influenced the development of Adolf Hitler’s expansionist strategies. From 1925 to 1939, Haushofer broadcast monthly radio lectures on the international German political situation. His *Welt politischer Monatsbericht* (World political monthly report) made him a household name in contemporary Germany, and he came to be well known in circles far removed from academia. The term *Lebensraum*, which was introduced to Hitler via Hess and Haushofer, who was the first to apply it in that context, first entered the Nazi lexicon in Hitler’s bible, *Mein Kampf*. Much of what was found in *Mein Kampf* was a reflection of the 19th-century social Darwinism that both Hitler and Haushofer shared.²² In his book, Hitler adopted the *Lebensraum* goal that was used to motivate global Nazi expansionism and genocide.

Summary

The concept of *Lebensraum* was first formulated in an attempt to apply Darwin’s evolutionary theory to geography and ethnography.²³ In the end, Darwinism had an enormous influence on the development of Nazi ideology, as a result of the influence of not only Hitler, but also Karl Haushofer and Friedrich Ratzel. Darwinism was thus a major influence in causing World War II and the Holocaust, the extermination of what were judged as inferior races.⁴ As Weikart concluded:

“... Hitler’s belief that population expansion is necessary and beneficial was rooted in Darwinian ideology. ... the Darwinian struggle for existence—especially the struggle between the races—played a central role in Hitler’s worldview. In the Darwinian struggle for existence, organisms, especially those of the same species, compete for scarce resources to sustain an expanding population. Hitler followed the vocal Darwinist geographer Friedrich Ratzel in interpreting the struggle for existence as primarily a struggle for living space (*Lebensraum*) ... Hitler believed that the struggle for existence among humans necessarily involved military conflict.”²⁴

Thus, WWII was regarded as justified by Hitler and his government, no matter what the cost. The estimated total deaths caused by World War II were close to 18,000,000 in the USSR, and an estimated 5,800,000 Poles died (20% of Poland’s pre-war population). Furthermore, 298,000 Americans died plus about 4,200,000 Germans and 1,972,000 Japanese.

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Racemization of amino acids under natural conditions: part 5—exaggerated old age dates

Royal Truman

Amino acid racemization has been used for dating purposes. Many environmental factors can be used to support or discredit ages consistent with presuppositions, including temperature, pH, degree and timing of mineralization, accelerated racemization of hydrolyzed peptide fragments, degradation of collagen, preferential leaching or retention of high D/L fractions, and contamination with L-amino acids from the environment. Putative older samples consistently fail to produce the high D/L ratios expected by old-earth paleontologists, and lower racemization rate constants are assumed instead of challenging the assumed dates. We show that dates based on proportion of amino acid racemization can be reliably recalibrated to predict dates which do not exceed the age of the Genesis Flood.

Rates of racemization in fossilized samples

In parts 1–4 of this series, we showed that large peptides consisting of almost only L-amino-acid (L-AA) residues will not form under plausible aqueous conditions.^{1–4} Now we will address another naturalist challenge to belief in a young creation. D/L AA enantiomeric ratios have been claimed to show various organisms died tens of thousands to millions of years ago. Evolutionists often claim that dating methods produce very similar results, often demonstrating ages beyond ten thousand years. We will examine two representative cases involving dating of human bones and fossil mollusks. The intention here is not to provide an extensive review of the dating applications based on AA racemization but to elucidate key recurring principles which can be applied to other dating studies.

Aspartic acid (Asp) is the most often used AA for racemization dating, see figure 1.

Once the date and D/L-Asp ratio are known for one sample, presumably this information can be used to date other samples after determining their D/L-Asp values. This assumption neglects much of the underlying chemistry occurring. The rate of increase of D-Asp is not linear when plotted against other AAs such as alanine, displaying a rapid initial phase in heated collagen.^{5,6} Smith and Evans have suggested that the slower-rate region reflects increasing proportion of free Asp due to hydrolysis of peptide bonds with time, since free AAs racemize more slowly than residues at the end of peptides.⁷

Goodfriend demonstrated that Asp also arises from deamination of asparagine (Asn), providing an additional pathway to generate L-Asp.⁸ Asx is commonly used to

represent the measured concentration of Asp when it includes contribution from Asn \rightarrow Asp. Goodfriend also suggested that the complex pattern of Asx racemization may be due to differences in the rate of an intermediate cyclic succinimide (Asu) which can racemize rapidly.⁸ Forming Asu introduces considerable strain on the surrounding peptide backbone and will therefore be strongly affected by temperature.^{9,10}

Discrediting unexpected ages in the distant past can be done by claiming that some factor or other diverged between the calibrating sample vs the one to be dated.

Increases in D-Asp are used in forensic sciences for estimating age at death back to relatively recent times, but this will not be discussed further here.¹¹

If the age is believed to be known, some scientists believe information can be obtained about average paleotemperatures by calculating a racemization rate constant, but this can lead to evolutionary circular reasoning by confusing measurable facts with calibrated dates.^{12,13}

Part 1. Old ages reported for bone samples

We will discuss next a well-known controversy among paleontologists involving significantly discordant dates reported for several Californian Paleoindian skeletons. This provides valuable insights into how paleontological dating works in practice, and principles to reflect upon in our creation vs evolution discussions.

When an organism dies, the proteins first hydrolyze at labile peptide bonds such as for serine and aspartic acid residues. The resulting peptide fragments continue to hydrolyze, leading eventually to free amino acids. Bada *et al.* have developed a dating method based on the amount

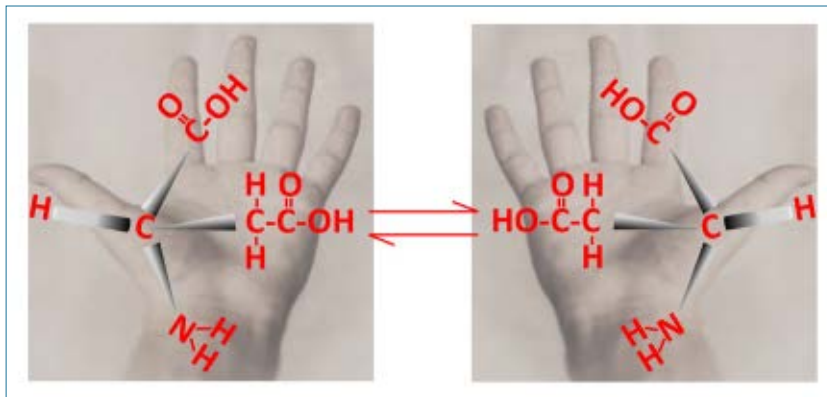


Figure 1. Racemization of D- and L-aspartic acid (Asp)

of Asp racemization found in bones, calibrated using samples assumed to have been subject to similar conditions, which were dated using ^{14}C . Under conditions of extreme desiccation, racemization could be much slower even at high temperature.¹⁴ However, bones generally contain enough water that this is not an important factor.¹⁵

It is common to use surrogate laboratory methods which are cheaper, faster, easier to perform, or require less sample material. Bada's procedure offered the advantages of not having to calculate racemization rate constants for multiple fluctuating temperatures; being able to use much smaller test samples; and being applicable to dates older than ^{14}C could reliably determine. This is because in bone at 20°C the half-life for Asp racemization has been estimated to be ~15,000 years, whereas that of ^{14}C is ~5,700 years.¹⁶

The principle is to radiocarbon date a fossil sample and measure its D/L. The D/L of other bones from the general area are then used to estimate their ages, assuming exposure to similar environmental factors, especially temperatures.¹⁶

The procedure was applied in 1974 and 1975 to several North American Paleoindian skeletons, with ages reported to be 40,000–60,000 years.^{15,17} Bada *et al.* claimed these results were in close agreement with radiocarbon ages^{18–20} and that “the results of which provide additional evidence that man was present in North America more than 40,000 years ago.”¹⁶ Additional evidence? Such statements from a 32-year-old associate professor did not sit well with the established paleontologists convinced that humans had migrated into the Americas about 13,000 years ago. A lively debate drew in many participants, leading to deep skepticism on the validity of the racemization method *in toto*.²¹ Much was at stake: reputations, whose proposals get funded, who attracts the brightest graduate students, and career prospects.

Bada and allies forcefully defended their position, denying charges of non-reproducible results and adding evidence to show that a coherent evolutionary picture

resulted. For example, racemization analyses of Upper Pleistocene–age horse bones collected from near the Del Mar¹⁹ and Sunnyvale²² Paleoindian sites were offered to support the claim the human skeletons were Upper Pleistocene in age.

Studies by another research team using the uranium decay series method on the Del Mar and Sunnyvale skeletons led to radiometric ages four to five times younger than the estimated aspartic acid racemization ages had.²³ However, Bada *et al.* claimed that U-series ages always tend

to be younger by as much as two to three times than the actual burial ages of Upper Pleistocene fossil bones.^{15,24,25} Notice how easily ages which contradict ‘known’ dates get discarded, whereas those calibrated to give ‘good’ results are retained.

A new radiocarbon dating technique utilizing accelerator mass spectrometry (AMS) applied to several of the disputed Paleoindian skeletons produced dates about ten times lower.¹⁵ This was a stunning development, implying much faster $\text{L} \rightleftharpoons \text{D}$ interconversion rate constants, k , for Asp. Can experts simply change laboratory results like rate constants by about an order of magnitude? If other evolutionists had not had a personal stake in defending their publications the former ~60k dates would have continued to be among the ‘scientific facts’ disproving a recent creation. And we will propose that the new rate constants for Paleoindian skeletons are probably still too low!

Critical evaluation of the dating of bones

Thanks to the efforts of highly motivated opponents, many chemical facts were brought to light which would have been neglected had the simplistic original assumptions remained unchallenged. It has been observed that samples having less amino acid content seem to correlate with higher k -interconversion Asp values. Perhaps as collagen breaks down through peptide bond hydrolysis ever more aspartic acid residues end at the N-terminal position of peptide fragments where racemization is fastest (i.e. higher k values).^{26,27} Leaching of some fragments and free AA would lead to less total AA content in those samples.

Considerable differences were found in the extent of collagen preservation in Californian Paleoindian skeletons thought to be of similar ages. Plausible causes proposed include leaching by groundwaters, and/or heating effects resulting from either shallow burial depths or cultural burial practices.¹⁵ Also, many of these skeletons come from

coastal ecological environments where carbonates may have accelerated the rate of collagen hydrolysis.²⁸ The strongly argued claim that k values would be very similar for nearby organic remains has been thoroughly discredited.

Insights from bone studies on samples from Tanzania

In fossil carbonates, the most highly racemized components are free amino acids, which could have arisen from internal aminolysis followed by hydrolysis in bones.^{29,30} These soluble AAs could be preferentially leached out, especially in the case of bone samples. Studies using bones from the Olduvai Gorge (in Tanzania) indicated that samples from the famous Nasera rock shelter (2,180 years old, $k = 6.7 \times 10^{-5}$ for Asp) are much more extensively leached than samples from the nearby Olduvai excavations (1,360 years old, $k = 7.4 \times 10^{-5}$ for Asp).¹⁵ Nevertheless, the calculated k values for Asp were about the same, *contra* the expectation that hydrolysis and subsequent leaching would significantly lower the average D/L ratios in the samples measured.

Studies from the Nasera excavations showed the D/L-Asp ratio remained at ~ 0.5 , starting from ~ 2 m throughout the remaining lower sections (~ 4 – 5 m).¹⁵ Samples from level 3A were claimed to be 2,180 years old ($k = 6.7 \times 10^{-5}$) and from level 5A 21,600 years old ($k = 1.8 \times 10^{-5}$).¹⁵ A sample from the Naisuisui Beds was claimed to be 17,500 years old ($k = 1.5 \times 10^{-5}$).¹⁵ We recognize the familiar pattern of putatively older samples being assigned considerably lower average k values, instead of using the D/L values plus calibration sample to shorten the putative ages. As another example, a sample from the Upper Ndutu Beds with an aspartic acid age calculated to be 33,000 years was dated using ^{14}C to be only $3,340 \pm 800$ years old.¹⁵

After about 80,000 years the fossil bones from the Olduvai Gorge region should have D/L aspartic acid ~ 1.0 . However, a fossil bone from the Masek Beds, with dates ranging from $\sim 450,000$ to $600,000$ years, had a D/L Asp ratio of ~ 0.75 . Samples from other older stratigraphic levels showed even lower D/L ratios.¹⁵ These results could be interpreted as having been contaminated by aspartic acid from surroundings, or of course that they are of similar ages.

Many discrepancies with radiocarbon dates

Using racemization of Asp to date samples more than a few hundred years old often yields discordant results. A living anemone, *Gerardia*, was dated as being 1,800 years old by ^{14}C but only 250 years by extrapolation from high temperature Asx experiments.^{31,32}

A mean D/L Asp ratio of only 0.084 from an insoluble fraction was reported for a putatively 20,000-year-old bone from the Taishaku Konondo Cave Site in Japan. This was surprising, especially since the average temperature was

believed to have been 19°C , so racemization should have been fairly rapid.³³

Experiments suggest that Asx in rat dentine appears to racemize ten times faster than human dentine.³⁴ Perhaps the variability among human teeth remains is also considerable. Furthermore, rates vary with what portion of the dentine material is measured. Many studies of dentine proteins found a much faster rate of racemization in the soluble protein fraction.^{35,36} Soluble proteins contribute to the increase in D-Asx seen in dentine with time, but countering this, water-soluble materials are more easily leached out.

In samples of historical ages, the D-Asx concentrations in dentine collagen all tend towards a consensus value, independent of age, over periods of mere decades to centuries.^{12,37–39} This has been interpreted as due to loss of faster racemizing soluble proteins and contribution of fully racemized Asp deriving from the $\sim 10\%$ non-collagenous proteins (NCPs) present in bone and teeth.¹²

Temperature fluctuations and degree of mineralization are critically important. AA racemization is unlikely to occur in triple helical collagen below its denaturation temperature (T_m). The T_m is quite high for demineralized collagen ($\sim 68^\circ\text{C}$), and very high for mineralized collagen ($\sim 150^\circ\text{C}$).

These facts should create deep skepticism about very ancient dates assigned to bone or tooth samples, based on measured Asp D/L values.

Looking deeper into racemization of aspartic acid

Investigations now report that a particular calibration constant should only be used to date other fossil bones having amino acid content very similar to that of the calibration samples.^{40,41} Asp racemization is affected by other AAs present.

Can a fixed k be assumed for thousands or tens of thousands of years? Young-earth scientists believe oceans and coastal regions after the Flood and through the Ice Age ($\sim 2,300$ – $1,800$ BC) were much warmer. Suppose a much younger desiccated sample from a dry and cool period or location is used for calibration purposes. A time, t , is assigned from radiocarbon dating, which, with a measured D/L value, leads to a value for k , calculated using [1]. In [1], the t_0 term corrects for D-Asp already present when the organism died or was introduced during laboratory processing.⁴²

$$\ln \left[\frac{1 + D/L}{1 - D/L} \right]_t - \ln \left[\frac{1 + D/L}{1 - D/L} \right]_{t_0} = 2kt. \quad [1]$$

A new sample is now to be dated which had been exposed to decades or hundreds of years of a much warmer and humid prior environment, perhaps also with soluble basic racemizing minerals present. Due to the much higher k

value, this automatically results in a high D/L ratio, so that extrapolating with the k value from the non-representative calibration sample predicts ages which are too old.

To illustrate the effect of temperature on k , suppose that shortly after the Genesis Flood on the California shoreline when an individual was buried the *effective temperature* was 30°C. A few hundred years later assume the effective temperature was 15°C when the calibrating sample was collected.⁴³ An ‘effective temperature’ difference of 15°C could result from a much smaller ‘average temperature’ difference than 15°C.⁴³ From the Arrhenius equation [2] we find the difference in $\ln(k)$ leading to expression [4],

$$\ln k = Ae^{-E_a/RT} \quad [2]$$

$$\ln k_1 - \ln k_2 = \left(-\frac{E_a}{RT_1} + \ln A\right) - \left(-\frac{E_a}{RT_2} + \ln A\right) \quad [3]$$

$$\ln\left(\frac{k_1}{k_2}\right) = -\frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \quad [4]$$

We use $E_a = 38$ kcal/mol for Asp in bone, and $R = 1.9872$ cal/K•mol, which leads to $k_1/k_2 = 26$ for the 15°C difference.⁴⁴ With much higher moisture and possibly catalyzing metal cations like Cu^{2+} in the post-Flood costal environment, the $L \rightarrow D$ rate constant might have even been up to ~100 times higher than presumed using the calibrating sample. Thousands of years would not be necessary to obtain a large difference in D/L between both specimens.

We collected data reported using only AMS for dating to determine if there was the expected strong correlation between reported ages and D/L values, and the resulting k values (see table 1). In all cases low measurement error values were claimed.

From table 1 we see that the youngest age now being reported is $1,650 \pm 250$ years with a high D/L = 0.50, whereas

Table 1. Radiocarbon age using accelerator mass spectrometry (AMS), D/L and calculated racemization rate constants k reported for Californian Paleoindian bone samples. Data from ref. 15. **A:** all AMS data only **B:** comparison of data using the same specimens.

A						B				
Sample	Age (yrs ^a)	Error	D/L ^g	k^e , 10 ⁻⁵ /yr	k^f , 10 ⁻⁵ /yr	Sample	Age (yrs ^a)	Error	D/L ^g	k^f , 10 ⁻⁵ /yr
Yuha ^c	1,650	± 250	0.50	29	29	Stanford I ^d	4,830	± 150	0.14	1.5
Yuha ^c	2,820	± 200	0.50		17	Stanford I ^d	4,950	± 130	0.14	1.4
Los Angeles ^b	3,560	± 220	0.35	8.3	8.3					
Sunnyvale ^c	3,600	± 600	0.50	13	13	Sunnyvale ^c	3,600	± 600	0.50	13
Yuha ^b	3,850	± 250	0.50	12	12	Sunnyvale ^b	4,650	± 400	0.50	10
Sunnyvale ^b	4,650	± 400	0.50		10	Sunnyvale ^c	4,850	± 400	0.50	9.9
Stanford I ^d	4,830	± 150	0.14	1.5	1.5	Sunnyvale ^d	6,300	± 400	0.50	7.6
Sunnyvale ^c	4,850	± 400	0.50		9.9					
Stanford I ^d	4,950	± 130	0.14	1.5	1.4	Yuha ^c	1,650	± 250	0.50	29
Laguna ^d	5,100	± 250	0.25	3.6	3.6	Yuha ^c	2,820	± 200	0.50	17
Del Mar ^d	5,400	± 120	0.48	8.4	8.4	Yuha ^b	3,850	± 250	0.50	12
Sunnyvale ^d	6,300	± 400	0.50	7.6	7.6					
La Jolla (SDM 16709) ^d	8,470	± 140	0.19	1.5	1.4					

^a Accelerator mass spectrometer-based ages.

^b Radiocarbon age of the HCl-insoluble organic fraction.

^c Radiocarbon age of the HCl- or NaOH-soluble organic fraction.

^d Radiocarbon age of the total amino acid fraction.

^e Reported in ref. 15.

^f Our calculations, using $k = \frac{1}{2} \times (\ln((1 + D/L)/(1 - D/L))_t - \ln((1 + D/L)/(1 - D/L))_{t_0})$, where $\ln(1 + D/L)/(1 - D/L)_{t_0} = 0.1402$ based on an assumed D/L = 0.07.

^g The samples were all hydrolyzed for 24 hr; thus the D/L for $t = 0$ value was set to 0.07 for these experiments.

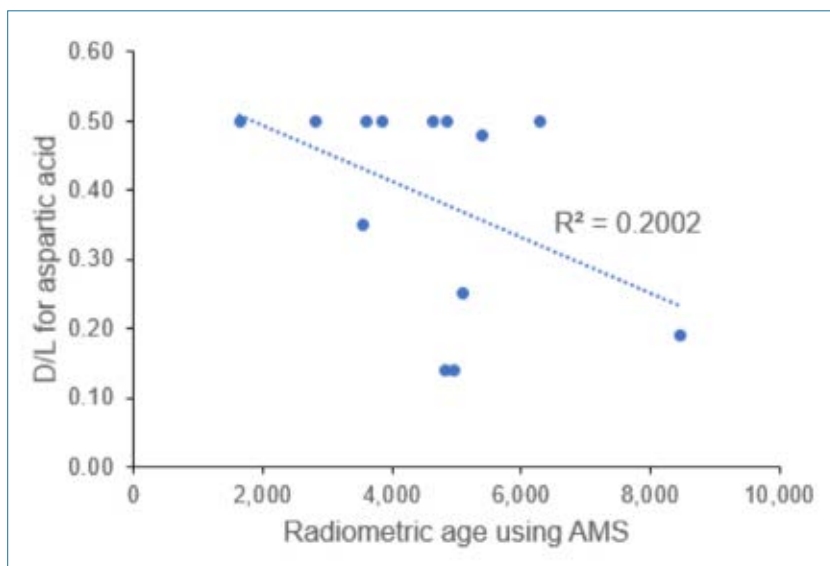


Figure 2. Age vs D/L of aspartic acid reported for Californian Paleoindian samples radiocarbon dated using AMS. Data from ref. 15.

the oldest age is $8,470 \pm 140$ years and $D/L = 0.19$. This is the opposite of what this dating methodology demanded. Figure 2 confirms that the D/L values are not consistent with the claimed ages.

We distrust the dates calculated. From table 1B, for the Sunnyvale specimen, $D/L = 0.5$ was always used to calculate the k values, whereas the radiometric ages ranged from 3,600 to 6,300 years. Different organic fractions were used for the AMS measurements, but this should not affect the radiocarbon outcomes. Surprisingly, D/L values were apparently not determined for the alternative organic fractions. For the Yuha specimen, $D/L = 0.5$ was also reported, with AMS-based dates between 1,650 and 3,850 years. Of the 13 entries in table 1A all but four were reported to have a $D/L = 0.48$ – 0.50 , despite very different ages.

Using a calibration curve to force AMS and racemization dates to agree

Figure 3A shows how the calculated k values range from 1.5×10^{-5} to 29×10^{-5} despite an assumed constant environment.

The claim that D/L ratios are reliable indicators of age is incorrect. The allegedly oldest specimen (La Jolla, 8,470 yrs) displayed very little racemization (uncorrected $D/L = 0.19$, of which 0.07 is assumed to have been present initially!).

Recall that over time proteins would hydrolyze to peptide fragments, leading to ever more aspartic acid residues at an N-residue position, which racemize the fastest. k values should accelerate for older samples. However, on average,

lower k values are reported for older putative ages, which I have not found pointed out anywhere in the literature. This is remarkable, having seen that three highly reproducible radiocarbon dating methods with insignificant relative errors produced very discordant ages for the same samples.

Perhaps we could recalibrate the data to produce useful results. We selected a sample having several measurements, a high D/L value (so that the relative error is small), and an AMS date younger than the Flood to minimize opportunities for periods of abnormally high temperature and moisture. The best candidate is the Yuha specimen, and we will use the average value for k . This date would also alleviate concerns of accelerated radioactive decay effects during the Flood period, as proposed by the RATE project, which could invalidate the AMS results.⁴⁵ In the next sections we will

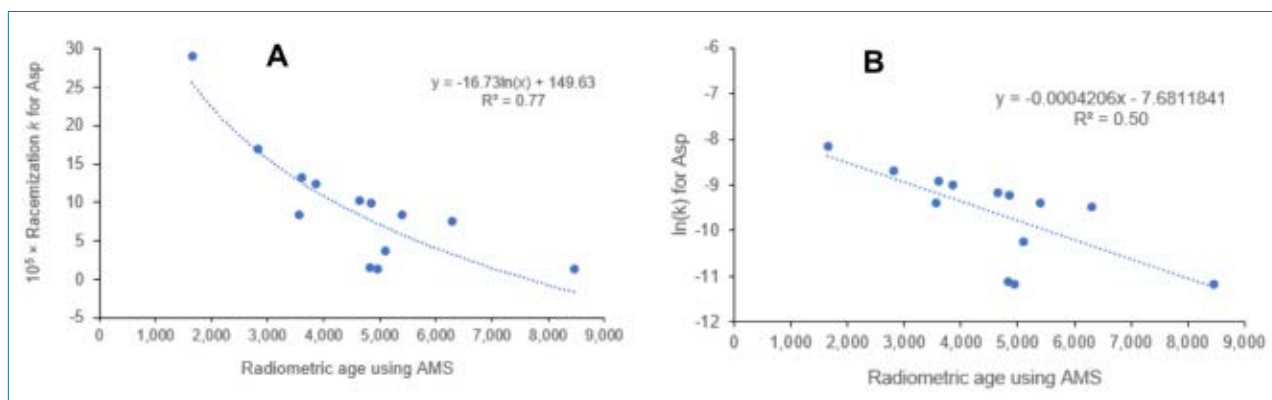


Figure 3. Age vs racemization constant k for Californian Paleoindian samples radiocarbon dated using AMS. Data from ref. 15. **A:** Untransformed data **B:** plot using $\ln(k)$.

examine the relationship between D/L, k , and ages, so we need to first provide a mathematical basis.

Using rate constants to predict time to achieve D/L values

Amino acid racemization almost always occurs with the same rate constant, k , in the forward and reverse direction

$$L \rightleftharpoons D. \quad [5]$$

When an organism dies, its proteins will possess almost only L-AAs. Under unchanged conditions of temperature, pH, and so on, there is a simple mathematical relationship between D/L ratio and the rate constant for most AAs⁴⁶

$$k = \frac{1}{2t} \ln \frac{1 + D/L}{1 - D/L} \quad [6]$$

where t is the time AA interconversion occurred.

Let us assume that when the organism died at time t_0 , D/L = 0. We divide time into short slices and abbreviate $[L]_{\text{time}=t}$ as L_t . A bootstrap sequence of events allows us to calculate L_t at the end of each time slice as the sum of L_{t-1} at the beginning of the interval, minus the amount which converted to D, plus the initial amount of D present at that time slice which converted to L

$$L_t = L_{t-1} - kL_{t-1} + kD_{t-1} \quad [7]$$

$$D_t = 1 - L_t. \quad [8]$$

For a sequence of short time intervals this works very well. During each time interval some of the $L \rightarrow D$ produced will revert, $L \leftarrow D$ contributing $k(L_{t-1})$ to L. Of this small quantity, $k(k^2L_{t-1})$ would be lost back to D, and so on, equilibrating back and forth. As the number of refining

corrections increases the system converges to [9], derived in the Appendix

$$L_t = L_{t-1} + (D_{t-1} - L_{t-1}) \frac{k}{1+k} \quad [9]$$

which for $k \ll 1$ reduces to [7].

We could also use the relationship used in part 2 to find the concentration of L at the end of any time interval, t , using equation [10]

$$L_t = \frac{1}{2}(1 + e^{-2kt}), \quad [10]$$

derived after algebraic manipulations from $\ln(L_0/(2L_t - L_0)) = 2kt$, where $L_0 = 1$ at time = 0, and $D_t = 1 - L_t$.⁴⁴

We confirmed that D/L ratios calculated via [9] and [10] are virtually indistinguishable using Microsoft Excel, even for a relatively large value of k , starting at $t = 0$ out to $t = 500,000$ years, using time intervals of 1,000 years for each step. The D/L ratios found using the simple approximation [7] with [8] were also in close agreement. Some values are shown in table 2 at a few time durations.

Equations [7] and [8] are an approximation and, although not as precise as the other two algorithms, predict D/L values well within the variability of the data reported (see table 4, below). I chose this method to predict D/L values in this paper, being easiest to communicate the concept, namely that initially pure L-AAs in the fossil samples would equilibrate $L \rightleftharpoons D$ over time, and we wish to determine if one value for k could fit all the data points reasonably.

Predicted ages using the most plausible racemization rate constant

Bada and his colleagues use D/L = 0.07 in the $\ln[(1 + D/L)/(1 - D/L)]_{t=0}$ term in Eq. [1], obtained from the Asp enantiomeric ratio determined using a modern bovine bone

Table 2. Confirmation that different algorithms provide very similar D/L values as a function of racemization time and k . Alanine values taken from refs 47 and 48, with $k = 0.0085$ based on $t = 1,000$ -year intervals. $D_t = 1 - L_t$ where $t = \text{time}$.

	$L_t = L_{t-1} - kL_{t-1} + kD_{t-1}$	$L_t = L_{t-1} + (D - L)(k/(1+k))$	$L_t = 0.5(1 + e^{-2kt})$
Years	D/L		
1,000	0.0085729	0.0085000	0.0084998
10,000	0.0855214	0.0847979	0.0847959
100,000	0.6948681	0.6910802	0.6910695
200,000	0.9372114	0.9354142	0.9354091
300,000	0.9883973	0.9878819	0.9878804
400,000	0.9979012	0.9977753	0.9977749
500,000	0.9996218	0.9995932	0.9995931

Table 3. Ages, D/L and racemization constant calculated from Yuha Paleoindian samples, ref. 15

Sample	Age (yrs) ^a	D/L ^b	k^c , 10^{-4} /yr
Yuha ^d	1,650	0.50	2.9
Yuha ^d	2,820	0.50	1.7
Yuha ^e	3,850	0.50	1.2
Average:			1.95

^a AMS-based ages.

^b Hydrolyzed for 24 hrs.

^c Using $k = \frac{1}{2}t \times \ln((1 + D/L)/(1 - D/L)) - 0.1402$.

^d Radiocarbon age of the HCl- or NaOH-soluble organic fraction.

^e Radiocarbon age of the HCl-insoluble organic fraction.

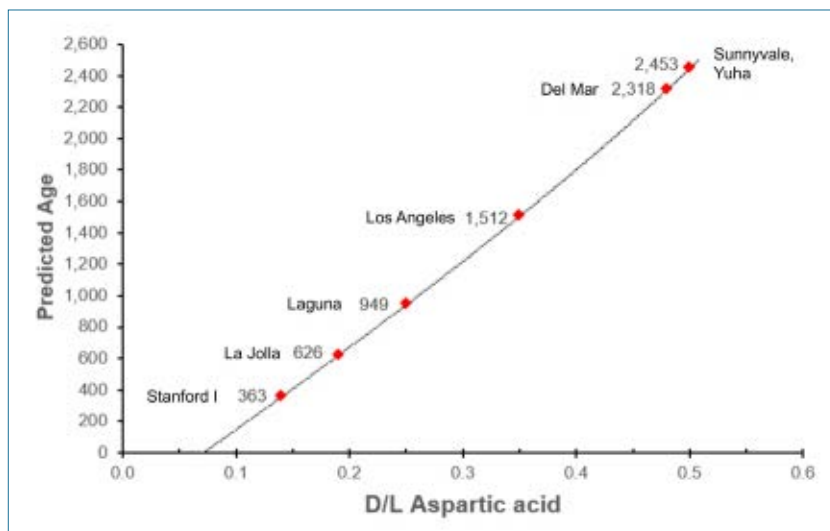


Figure 4. Predicted age in years of Californian Paleoindian specimens based on D/L racemization, calibrated using the average k of the Yuha finding. Bootstrap equations [7] and [8] were used, using $D/L = 0.07$ at time $t = 0$, and $k = 1.95 \times 10^{-4}$ /year.

Table 4. D/L ratios of amino acids from fossil Pleistocene mollusk shell samples⁴⁷

Age, years	Conditions	Aspartic acid	Alanine	Valine
D/L ratio				
50,000	desalted ^a	0.46	0.45	0.17
	sublimed ^a	0.45	0.39	0.19
	Wehmiller ^b	0.38	0.36	0.16
1,000,000	desalted ^a	0.98	0.89	0.80
	sublimed ^a	0.96	0.99	0.82
	Wehmiller ^b	0.88	0.95	0.85
Average D/L ratios				
50,000		0.430	0.400	0.173
1,000,000		0.940	0.943	0.823

^a Ref. 47.

^b Ref. 48.

Table 5. Rate constants k for $L \rightleftharpoons D$ amino acid interconversion using average D/L ratios from table 4.⁴⁷

Age, years	Aspartic acid	Alanine	Valine
k /year^a			
50,000	9.2×10^{-6}	8.5×10^{-6}	3.5×10^{-6}
1,000,000	1.7×10^{-8}	1.8×10^{-8}	1.2×10^{-8}

^a k calculated from equation [6].

carried through the same analytical steps as the fossil bones.⁴⁹ This leads to a correction value of 0.1402. We have doubts about the correctness of using this factor for all samples.^{50–52} Fujii *et al.* pointed out that some protein positions rapidly accumulate D-Asp residues as organisms age.⁵³ Why should the initial D/L be identical for all human samples? The D/L ratio in bones are believed to correlate strongly with the ratio of non-helical to triple helical collagen. Initially the D/L ratio will trend towards a value of 0.09, due to complete racemization of the non-helical telopeptides.¹²

Nevertheless, to ensure consistency with reported data we will assume that at time $t = 0$, $D/L = 7.00\%$ ($L = 93.46\%$, $D = 6.54\%$). This shortens the time necessary to achieve a measured D/L. We used the three AMS ages for Yuha from table 1 with the $\ln[(1 + D/L)/(1 - D/L)]_{t=0}$ correction to calculate an average k value (see table 3).

We used $k = 1.95 \times 10^{-4}$ /year and the measured D/L values (from table 1) to calculate new, calibrated ages for the other Paleoindian samples as shown in figure 4. If the new calibrated dates are correct, then most of these American Indians lived in the Christian era.

Part 2. Old ages for mollusk shells

In one study, Glavin and Bada examined two fossil Pleistocene mollusk shell samples with assumed ages of 50 ka and 1 Ma to validate a new analytical method.⁴⁷ This is an example of confusing empirical data with evolution-based date presuppositions. D/L ratios were reported using three sample preparation methods to extract aspartic acid, alanine, and valine (see table 4).

Applying equation [6] to the average D/L ratios in table 4 led to a k for the alleged 50-k-old fossil about 400 times higher than for the putative 1-million-year-old one (see table 5).

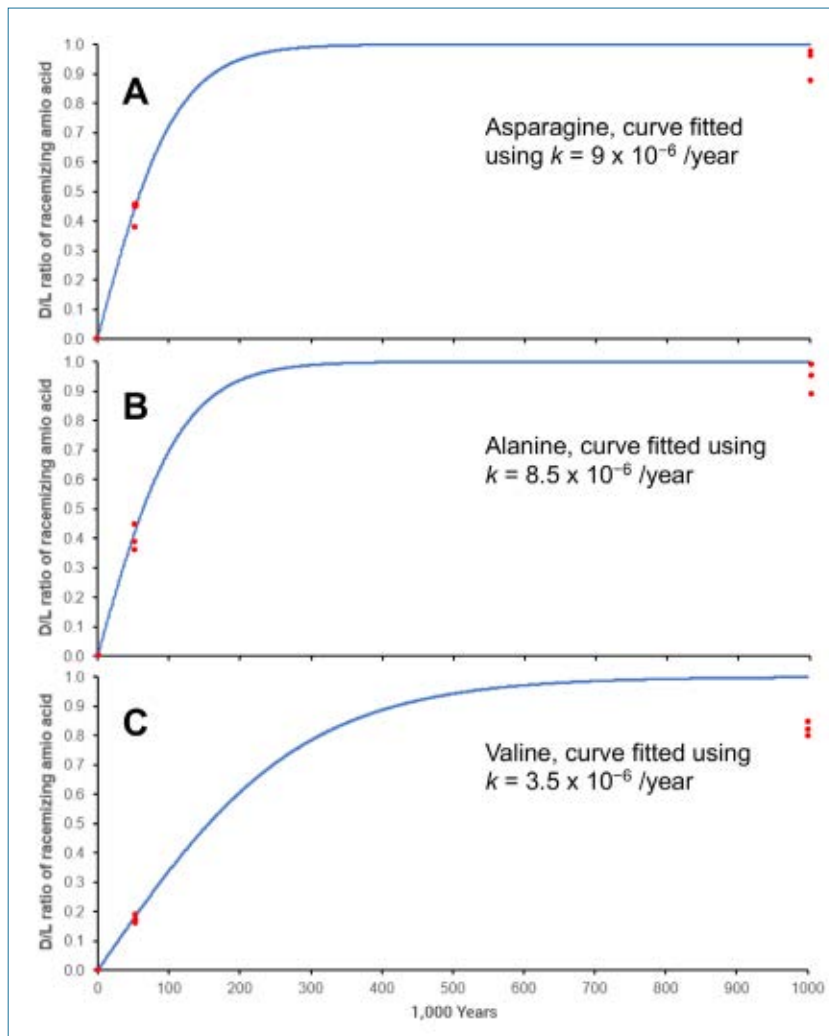


Figure 5. Change in D/L for Pleistocene mollusk shell samples as described in the main text. Best results were **A:** aspartic acid, $k = 9 \times 10^{-6}$; **B:** alanine, $k = 8.5 \times 10^{-6}$ and **C:** valine, $k = 3.5 \times 10^{-6}$. Red circles are the individual values reported in ref. 47.

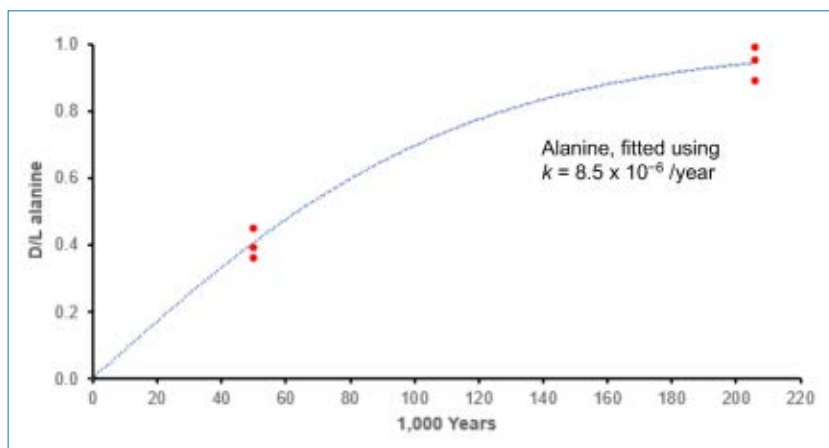


Figure 6. Predicted D/L for alanine using Pleistocene mollusk shell samples, using $k = 8.5 \times 10^{-6} / \text{year}$, bootstrap algorithm [7] and [8] and adjusting the 1 million to the age thereby predicted.

These k values are about one to three orders of magnitude lower than reported for AAs by Steen *et al.* using sedimentary material.⁵⁴ Fossilization likely slows down AA residue inter-conversion through strong binding to various minerals and presence of less water, but a researcher cannot know when or how much fossilization had occurred. The higher D/L ratio in the allegedly older sample might have resulted from exposure to periods of higher temperature preceding fossilization.

Goodfriend and others proposed using empirical power-function transformations of the D/L data for both mollusk and ostrich shells.^{55,56} Different power-functions were necessary for different taxa, which still failed to produce good results over the full range of values.⁵⁶

We can find the best value for k assuming similar environmental factors, and that the major process is simple $L \rightleftharpoons D$ interconversion, beginning with $t = 0$ at $D/L = 0$. We tested different values for k by trial and error using equations [7] and [8], using 1,000-year intervals over a million years. A single rate constant cannot fit the clusters at time = 0, 50 k, and 1 million-years (see figure 5 for the best results).

Perhaps racemization slows down with degree of fossilization but by how much and when would be unknown. More accurate dates are unknowable without a complex, valid fossilization model.

Correcting for error in assumed ages

The D/L values for the three curves in figure 5 were carefully measured repeatedly, whereas the dates are heavily burdened by assumptions. Clearly the D/L values predicted by extrapolation to 1 million years are too high. An obvious hypothesis would be that the assumed dates are far too large. A rough visual inspection of figure 5 suggests that decreasing the million

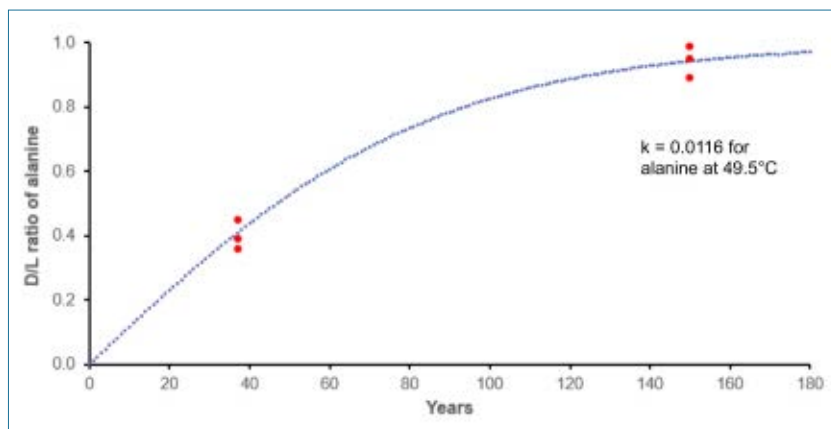


Figure 7. D/L for alanine over time, using $k = 0.0116$ /year at 49.5°C , based on sedimentary material 3.5 m under the ocean floor from ref. 54

years by about a factor of five would lead to far better results. To illustrate, we repeated the bootstrap calculations used to produce figure 5B with an age far less than one million years (see figure 6).

The value of $k \approx 8.5 \times 10^{-6}$ for alanine is suspiciously low, considering that Steen reported $k = 4.8 \times 10^{-5}$ /year for sedimentary material 3.4 m under the seafloor at an average temperature of 3°C .⁵⁴ A much larger k for the Pleistocene samples would imply that the 50 k age is also seriously inflated.

Dating taking the Genesis Flood into account

Let us assume these Pleistocene fossils resulted from sedimentary burial during the Flood or its aftereffects. Much higher coastal temperatures would have been caused by processes such as rapid tectonic subduction, volcanos, and meteorite crashes. Temperature and pH differences, even for relatively short time periods, have a large effect on racemization.⁵⁴

We used $k = 0.0116$ /year for alanine measured at 49.5°C (the lowest temperature having a reported k) for sedimentary material collected 3.4 m under the seafloor, using the bootstrap algorithm [7] and [8] to predict time to produce the fossilized D/L values.⁵⁴ 49.5°C might seem high, but this would be the effective and not average temperature. The temperature could also have been much lower, with k remaining comparably high due to dissolved minerals like Cu^{2+} and high pH.

According to figure 7, only about 150 years might have been necessary for the Pleistocene fossils to attain a D/L = 0.95 for alanine and not a million years. Furthermore, racemization for Asp using the same sedimentary material at 49.4°C was almost five times faster ($k = 0.053$ /year).⁵⁴ Many alternative scenarios could be conceived. Rapid racemization in a semi-mineralized humid state and lower effective

temperatures could also have occurred during the ~500-year Ice Age during which warmer coastlines existed.

Large differences in the specific environments could be responsible for the differences in D/L values and not large differences in burial ages. We see how important researcher assumptions are.

Concluding remarks

Like all dating methods, which require enormous extrapolation into deep time, numerous factors could be used *post facto* to explain or discredit

age predictions. These explanations are conceptual and rarely possible to quantify.

Suppose one wishes to assign *higher* average k values to older samples. The researcher could argue that greater protein hydrolysis over time would generate more peptide fragments. This would increase the proportion of Asp located at end positions which interconvert faster at the flexible frayed ends. Presumably, these free AAs with high D/L proportion would remain trapped to a large extent in the fossil. In addition, more of the stable collagen triple helix would denature with time, accelerating hydrolysis.⁵⁷

Alternatively, suppose one wishes to assign *lower* average k values to older samples. Now one could argue that on average the sample has been longer in a fossilized state, which hinders racemization. (However, someone could also argue for the opposite effect: being loosely compacted longer with various minerals might accelerate racemization by facilitating extraction of the α -proton.) In addition, more time would produce ever more free AAs or small, soluble peptides through hydrolysis. These would be responsible for most of the higher D/L proportion, but now it is argued that, being soluble, they leach out, leaving an excess of non-racemized collagen behind.^{58,59}

Note that reasons for ‘anomalous’ dates of k values could be applied to either the calibrating sample or the one of interest. Once a plausible narrative has been reasoned out amenable to the researcher’s presuppositions, it is often easy to believe one’s own explanations.

I agree with Collins’ assessment that

“Despite the large number of experiments which have been conducted to derive kinetic parameters for Asx racemization, when applied to fossil material the pattern and rates are unpredictable.”¹²

Appendix—Derivation of equation [9]

We wish to find a general mathematical expression for the concentration of an L-enantiomer AA during any time interval. This would permit us to use a bootstrap method to calculate L and D/L values over time.

Define L_t = concentration of L at the end of period slot t

$$L_{t(\text{initial})} = L_{t-1} \quad [11]$$

During a time slot, $L \rightleftharpoons D$ occurs with rate k in both directions:



A fraction of the enantiomers just produced can revert:



Of these reverted enantiomers, some can interconvert



Combining terms

$$L_t = L_{t-1} + L_{t-1}(-k + k2 - k3 + k4 \dots) + D_{t-1}(k - k2 + k3 - k4 \dots) \quad [18]$$

$$L_t = L_{t-1} + (L_{t-1} - D_{t-1})(-k + k2 - k3 + k4 \dots) \quad [19]$$

For $k < 1$ the series $(-k + k2 - k3 + k4 \dots)$ has a well-known solution. Set $z = -k$ and note that $z^{n+1} \rightarrow 0$ for small values of k .

$$\sum_{x=1}^n z^x = \frac{z - z^{n+1}}{1 - z} \approx \frac{z}{1 - z} \quad [20]$$

$$L_t = L_{t-1} + (D_{t-1} - L_{t-1}) \left(\frac{k}{1+k} \right) \quad [21]$$

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An evaluation of Hume's *Dialogues Concerning Natural Religion*

Andrew Sibley

Atheists, such as John Mackie, claim that David Hume's work *Dialogues Concerning Natural Religion* dealt a fatal blow to the intelligent design argument in the late 18th and early 19th centuries, well before Charles Darwin's work *On the Origin of Species*. Intelligent design has formed an important part of the arguments for belief in divine creation throughout Judeo-Christian history. This paper will examine the structure and arguments of the *Dialogues* and show that the design argument need not be defeated by Hume's writing. The analogy to human intelligence may be considered stronger than Hume admitted, even though the probabilistic nature of inductive inferences forces us to move to abduction; that is, choosing the best explanation. So, Christians may show that design is the better explanation, rather than alternative evolutionary ones. Hume's *Dialogues* also highlights a division between those who hold to prior faith commitments and evidential arguments; instead, believers should seek coherence between the two sides. In addition, Hume's work reveals an ambiguity in the concept of nature, between atheism and pantheism.

David Hume's work *Dialogues Concerning Natural Religion* was published in 1779, three years after his death. It is not an easy read, because it is written in the form of a dialogue (denoted as *Dialogues* below).¹ Atheistic commentators, such as John Mackie with his *The Miracle of Theism*, claim that it dealt a fatal blow to the design argument.² *Dialogues* involves a discussion between three characters: Cleanthes, Demea, and Philo, and is introduced through the words of Pamphilus to a friend, Hermippus. Cleanthes is presented as the tutor of Pamphilus. Pamphilus suggests that Philo is the careless skeptic, Cleanthes the accurate philosopher, while Demea is rigidly orthodox. While superficially supporting Cleanthes' view in the opening section, it doesn't seem to reflect Hume's actual position, with the design argument left as only a weak analogy to human intelligence by the end.³ The character Philo is given prolonged, almost unchallenged, discourse towards the end, which perhaps better represents Hume's position.

Cleanthes seeks to defend the classical design argument, which he does through an analogy to human intelligence. His views are closest to those of the modern Intelligent Design movement, and, in terms of apologetics, he may be considered the evidential apologist. Demea may be thought of as the presuppositional apologist, who argues that evidential approaches are weak because of a lack of certainty. Demea uses ontological and cosmological arguments,⁴ but also believes that people may experience the truth of religion within their hearts, apart from evidence.⁵ Philo, on the other hand, offers several objections to the design argument, which he derives from the ancient Greek

Epicurean perspective, but he also argues from the writing of Hesiod and Plato (*Dialogues*, p. 193, part VII; see figure 2).

Within the *Dialogues*, Demea's position is clearly separated from that of Cleanthes, and Demea initially forms an alliance with Philo. Demea later feels betrayed when he observes that Philo is taking his argument towards atheism. Cleanthes is forced to defend his position from both Demea and Philo. Philo attacks from two perspectives; one along the lines of the atheism of Epicurus, the second from wider Greek Paganism, and even Hinduism—Philo is seen exposing and exploiting the differences between the two positions of Demea and Cleanthes.

The three characters make use of theological reasoning, and both Demea and Philo argue, for different reasons, that children should not be taught about natural theology until the end of their education. Demea's position is based on concern about disputation in secular science and the obscurity of philosophy, and so he desires to first instil piety and reverence for the principles of religion in children's minds. Philo takes this view because he considers such teaching to be of no value. Cleanthes disagrees and argues that such skeptics as Philo are unable to live up to their own statements, and that everyone makes use of reason in support of their position, even where direct evidence is lacking (pp. 130–140). Interestingly, when Demea presses Philo (part VII) that his own argument may also be a form of a design argument, Philo doesn't strongly object, but merely asks whether the emergence of order must always be associated with an analogy to human intelligence; in other words, his is an impersonal mystical approach (p. 179).



Figure 1. David Hume, a Scottish philosopher who lived from 1711–1776 and questioned the design inference

Cleanthes vs Philo

Cleanthes argues his case through the use of analogical reasoning, where, for instance, the world is considered to resemble a great machine with living organisms playing a precisely ordered part as lesser machines in the whole. Such natural contrivances, Cleanthes argued, resemble human artefacts, but also exceed in complexity. Therefore, the ‘Author of Nature’ resembles in some way the mind of man, although, by inference, the designer is proportionally greater in intelligence and wisdom (pp. 141–151). Using as an example of contrivance the human eye, he comments:

“Consider, anatomize the eye; survey its structure and contrivance; and tell me, from your own feeling, if the idea of a contriver does not immediately flow in upon you with a force like that of sensation. The most obvious conclusion, surely, is in favour of design; and it requires time, reflection, and study, to summon up those frivolous, though abstruse objections, which can support Infidelity” (p. 154).

Philo accepts that all inferences are based on experience, but argues that our ideas about God are untrustworthy, and that analogical arguments must be based on exact similarities to be of value in terms of cause and effect. Humanity also lacks prior experience of the origin and formation of worlds, suggesting further that if ideas can organize themselves within God’s mind, then why not in material entities as well (pp. 149, 161, 165).

Philo elaborates on these ideas with an Epicurean perspective, suggesting that the order of the universe has

come about via finite particles moving through an eternity of time. The universe is then the source of its own order, and all combinations are available to bring about such observed regularity. Cleanthes rejects such assertions and asks how the benevolent and orderly aspects of nature could have arisen by such blind and random processes (pp. 182, 185). Philo offers Cleanthes a compromise which leads to the design argument being acceptable as only a weak analogy to human intelligence. Philo comments:

“If the whole of Natural Theology, as some people seem to maintain, resolves itself into one simple, though somewhat ambiguous, at least undefined proposition, that the cause or causes of order in the universe probably bear some remote analogy to human intelligence: if this proposition be not capable of extension, variation, or more particular explication: if it affords no inference that affects human life, or can be the source of any action or forbearance: and if the analogy, imperfect as it is, can be carried no further than to the human intelligence, and cannot be transferred, with any appearance of probability, to the qualities of the mind; if this really be the case, what can the most inquisitive, contemplative, and religious man do more than give a plain, philosophical assent to the proposition, as often as it occurs, and believe that the arguments on which it is established exceed the objections which lie against it?” (p. 227).

Philo VII

So, Philo’s initial argument in the *Dialogues* leaves the design argument as a weak analogy to human intelligence with very strict criteria. But Philo offers another possibility, also developing an argument based upon more esoteric Greek and Eastern religious beliefs in part VII. He asserts that the universe resembles more the product of an animal or vegetable than a human artefact because of the possession of self-generating or procreational powers. Therefore, the universe, by analogy, may be considered a living organism.

However, Cleanthes accuses Philo of making whimsical arguments that cannot convince. Philo responds with the belief that there is a source of generation within nature and that the world might possess a soul. Philo does, though, insist on asserting that “we have no data to establish any system of cosmogony” because human experience is imperfect and limited in extent and duration, and can therefore provide no “probable conjecture concerning the whole of things” (pp. 176–181).

Hume may simply be raising the notion of an animal-like world soul in order to use it as a tool against the design argument of Cleanthes on the basis that both are equally unlikely. But Philo goes further and asks what hypothetical

rule we ought to use to determine a choice, if forced to choose. Philo suggests that such a rule can be found in vegetation or generation by “examining the ancient system of the soul of the world” (pp. 176–177). Philo argues that his system involving a generating force offers a closer analogy than Cleanthes’ design argument because, he suggests, it is our experience that there is a power of generation in nature, and that the world is closer to a vegetable or animal than a machine.

“And does not a plant or an animal, which springs from vegetation or generation, bear a stronger resemblance to the world, than does any artificial machine, which arises from reason and design?” (p. 177).

Philo claims that his system is sourced from ancient mythologies, such as those of Hesiod and Plato, and also from the Brahmins, who believed the world arose from an infinite spider (p. 180).

“Hesiod, and all the ancient mythologists, were so struck with this analogy, that they universally explained the origin of nature from an animal birth, and copulation. Plato too, so far as he is intelligible, seems to have adopted some such notion in his *Timaeus*” (p. 180).

Hesiod was a Greek poet who lived around 700 BC; one of the works attributed to him is the *Theogony*, which is concerned with the origins of the world and of the gods. In this work, the goddess Venus (Greek Aphrodite) is connected allegorically to the power of generation.⁶ Venus is also mentioned in Hume’s *Natural History of Religion* as a power of generation.⁷

The Demiurge appears in Plato’s *Timaeus* as a divine craftsman, if understood in human terms, and was said to have fashioned and shaped the material world out of a pre-existing chaos; thus, it was necessarily imperfect. This is of course different from the Judeo-Christian view that God created everything out of nothing (*ex nihilo*), and declared it ‘very good’, later being corrupted by human rebellion. The Pagan texts were meant to be read more allegorically than the Jewish scriptures.⁸ The power of generation in Philo’s thinking, as derived from Greek mythology, is an impersonal or esoteric force of nature; one that has creative power through gradual evolution. It is one far removed from the classic intelligent design argument, but in harmony with an equivocation in the concept of nature (discussed further below).⁹

Cleanthes vs Demea

Hume also sets out in the *Dialogues* a sharp division between Demea’s and Cleanthes’ positions; as noted, Demea may be seen as the presuppositionalist, Cleanthes

the evidentialist. This division allows Hume to expose the weakness of each side, seemingly playing one off against the other, and provides a lesson for Christians who argue strongly between evidential and presuppositional apologetics (in truth, there is no reason for these two positions to be divided strongly; evidence may be used to show there is coherence between reality and prior faith commitments).

The discussion divides between:

1. Demea’s unknowable God and Cleanthes’ humanized deity.
2. Demea’s apparent fideism and Cleanthes’ evidence-based faith.

There is also disagreement between Demea’s belief that we cannot really know God’s purposes in the goodness and evil in nature and Cleanthes’ belief that we can infer God’s goodness from creation. Cleanthes is accused of overemphasizing the mechanical nature of creation, which presents God in anthropomorphic terms as a skilled engineer, although one greater in knowledge and wisdom. Cleanthes asks his hearers to look around the world as a whole, noting that people will find it “nothing but one great machine, subdivided into an infinite number of lesser machines” (p. 143).

“This machine-like quality is then subdivided to a degree that is beyond human sense comprehension and explanation. Since, therefore, the effects resemble each other, we are led to infer, by all the rules of analogy, that the causes also resemble; and that the Author of Nature is somewhat similar to the mind of man, though possessed of much larger faculties, proportioned to the grandeur of the work which he has executed” (p. 143).

Demea objects to talk of God as a designer, because it reduces God to a human scale (p. 156). Instead, he believes that God is ineffably sublime; that is, God is so elevated as to be unknowable. Demea claims support from the Platonists for the idea that knowledge of the nature of God is not possible (p. 138). He states that God is “altogether incomprehensible and unknown to us” (p. 141), and therefore Demea “could not approve of [Cleanthes’] conclusion concerning the similarity of the Deity to men.” Cleanthes’ argument, Demea thinks, gives an advantage to atheists and skeptics (p. 143). The two extremes in fact both potentially lead to atheism. The problem can be categorized as follows:

1. For Demea’s position: God is elevated so highly that he becomes unknowable.
2. For Cleanthes’ position: God is removed to the distant past or reduced to just a human agent.

In both positions God may disappear from view. Of course, Hume’s objection only works when we ignore the doctrine that mankind is created in the image of God, and that God has revealed himself to us through Jesus Christ. These

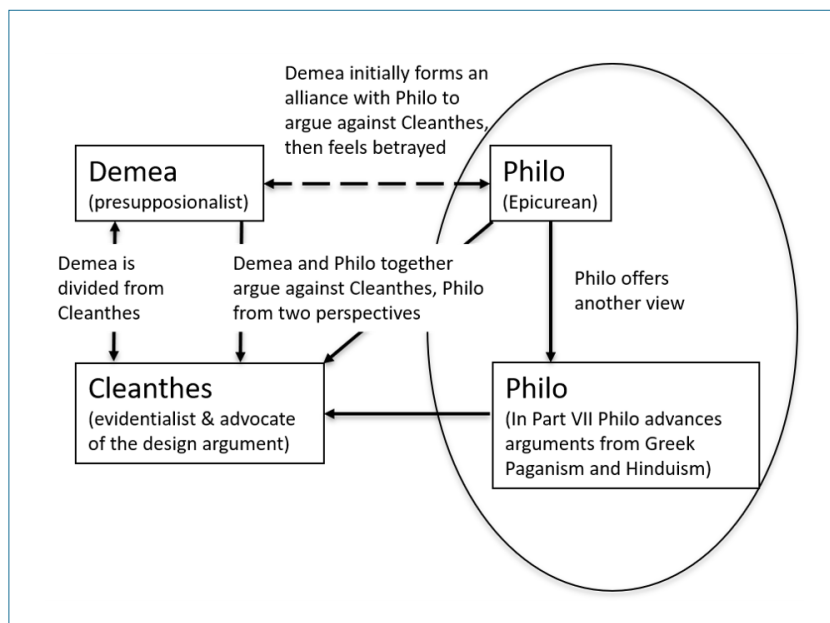


Figure 2. Graphical outline of Hume's *Dialogues*

doctrines arguably invite us to make an analogy to human intelligence and resist the error of the outlined extremes.

Despite Demea offering *a priori* ontological and cosmological proofs for God's existence, he states that people are able to feel the truth of religion in their own breast (p. 193).² Cleanthes' position, on the other hand, is evidence-based and inferential. Demea claims that Cleanthes' position is probabilistic and weak, and does not utilize rational proofs for the existence of God (p. 143). Cleanthes, on the other hand, asserts that Demea's position is, in effect, mystical, and so his understanding of God concedes ground to skeptics and atheists. Demea's response is to note that Cleanthes' position is, in effect, anthropomorphic, and that God is immutable and beyond comprehension; man's thoughts are often changing (pp. 158–159).

The third difference is that Demea believes the design argument is counter-productive; this because the world is evidently a place of brokenness, corruption, and trial, as well as showing goodness and beauty. Because God's mind and purposes are unknown, justification of God in light of such suffering is unnecessary (p. 193). Cleanthes' design argument, in effect, suggests that all of nature reflects the goodness of God, without taking into account the doctrine of the Fall of man (p. 143). In light of this observation of goodness and evil, the view of Demea is compelling, but such questions do not necessarily address the question of the existence of a designer and do not exclude reasons for suffering.

There are useful insights in the position of each side, but a coherent biblical and theistic understanding of design

will necessitate holding in balance the two positions of Demea and Cleanthes, instead of holding them in opposition, as Hume does.

Closing passages

Demea leaves the scene at the end of Part XI, with Cleanthes and Philo continuing the dialogue together. It may be noted that there are perhaps aspects of deistic implications in Cleanthes' position, while Demea's God is so elevated as to be unknowable. Cleanthes' cosmos works with clockwork precision, thus potentially removing God to a distant past or making God merely an uninterested observer. As noted, both Cleanthes and Demea assert that the other's argument will lead to atheism, one because God is elevated

so high as to be unknowable, the other because God is potentially reduced to the level of humanity. For much of the discussion Demea seems to support the notion of the incomprehensibility of God as argued by Philo, but, as the discussion continues, he finds Philo has really only been betraying his support.

"Hold! hold! cried Demea: whither does your imagination hurry you? I joined in alliance with you, in order to prove the incomprehensible nature of the Divine Being, and refute the principles of Cleanthes, who would measure every thing by human rule and standard. But I now find you running into all the topics of the greatest libertines and infidels, and betraying that holy cause which you seemingly espoused. Are you secretly, then, a more dangerous enemy than Cleanthes himself?" (pp. 212–213).

Cleanthes responds that all along Philo has been playing them off against each other and questions why Demea has been so slow in perceiving it. Cleanthes replies that from the beginning Philo, "has been amusing himself at both our expense ..." (pp. 212–213).

Discussion of *Dialogues*

Having set out an overview of the structure and arguments of Hume's *Dialogues* above, there are a number of questions that arise out of this. The first question is which character really represents Hume in the *Dialogues*? Commentators generally agree that it was Philo in the main. Hume allows Cleanthes to be the apparent winner of the debate, but

Gaskin observes that anyone reading the *Dialogues* is struck by the fact that Philo is really the hero and that this was where Hume's sympathy really lay.³

The motivation of Hume may have been to question the nature of God and not to openly question the existence of such a deity (p. 142).³ In the *Dialogues*, Philo is given the task of attacking the anthropomorphic design argument of Cleanthes, and thus questioning what further inferences can be made about the nature of such a designer. Hume was seemingly skeptical of many things, but he stated in private letters that he was not a complete atheist who believed nothing; instead believing some things about spiritual reality.^{3,10} Hume was also skeptical of arguments for atheism, and it has been suggested that he was more of an irreligious person as opposed to a complete unbeliever.^{11,12} Kemp Smith further claimed that Hume's skepticism arose from a dislike of the strict Calvinists.¹³ It has also been recorded that Hume attended the Jesuit Royal College of La Flèche for two years, and then proceeded to advance an argument with similarities to Buddhism.¹⁴ The Jesuits had tried to accommodate Catholic rites with those of other eastern religions, and such syncretism may shed light on Hume's own thinking.¹⁵ In *The Natural History of Religion*, Hume seems to suggest that monotheism is more rational than polytheism, but he finds the tolerance of pagan religions more appealing. The ambiguity in Hume's *Dialogues*, and other works, was perhaps useful as it meant it was difficult to categorize his real religious position. The publication of the work after Hume's death offered some protection from criticism and religious authorities, but Hume may also have been careful not to offend convention, which partly explains the structure of the work and why it has been so difficult to interpret.³ While Hume was probably not an atheist, and he recognized that skepticism is necessarily limited, he was skeptical of the power of inductive inferences,¹⁶ a stance he used against the design argument.

The atheist John Mackie has argued that Philo really represented Hume's view, and classified several objections to the design argument as follows:²

1. The design argument is based on a weak analogy to human intelligence.
2. Even if the natural order can be explained by analogy, there are other non-theistic explanations such as polytheism, pantheism, deism, or vegetation or generation. Philo also considers the possibility that the designer may be embodied.
3. How can the divine mind, which is postulated by the design argument, be explained?
4. The question of suffering and the goodness of God.
5. Even if the design hypothesis were to pass the previous four tests, it would have no explanatory power in science, rendering it useless as a scientific explanation.

There is insufficient room here to respond to points 3, 4, and 5 in depth; suffice it to say that they do not directly undermine the design argument. In one sense, in line with Demea's assertions, the divine mind needs no further explanation, if it is where all explanations necessarily stop; that is, if God exists outside of time and space, then explanations must cease. The question of suffering and the goodness of God would require a lengthy essay on its own and does not, in reality, question design. However, the evidentialist intelligent design proponent, as characterized by Cleanthes, is unable, or unwilling, to admit the Judeo-Christian doctrine of the Fall because that would entail *a priori* theological commitments.

In terms of explanatory power, it is invalid to say the design argument predicts nothing. In fact, a belief that the universe is intelligible allows science to begin, and one should expect to find complexity, which is analogous to design at multiple levels. Scientists discover things because they look for regularity; for example, the discovery of the DNA double-helix by secular scientists Crick, Watson, and Franklin. Such complexity and regularity can be understood and modelled with mathematical precision. In other words, the design paradigm allows us to do science and for science to progress.

So that leaves Mackie's points 1 and 2. It is noteworthy that for Hume to make his overall point against the analogy to human design he had to divide Demea from Cleanthes; that is, to divide the evidential from the presuppositional position. Unlike intelligent design proponents such as Cleanthes, this need not be the case for those who argue from the perspective of biblical creation. Christians can recognize the priority of faith for the believer, which is based upon revealed Scripture, but also recognize that evidence from design coheres with that belief. The doctrines of mankind created in God's image and that God has revealed himself more fully in the form of a man, through the person of Jesus Christ, invite us to make the analogy between human artefacts and those found in creation. Again, theological commitments are necessary to properly explain design. Of course, Hume is right that inductive inferences are unable to provide absolute proof, but that applies for much of science. Instead, Christian believers can recognize the importance of coherence with prior beliefs, with respect to the design argument, as opposed to offering formal proof.

Hume is also wrong to leave the design argument as only a weak analogy to human intelligence, which requires absolute equivalence to be valid. It is perfectly possible to see analogies between artefacts, even as we recognize that one exceeds the other in complexity. Consider two cars, one from the 1920s the other from the 2020s (figure 3). We can recognize the common design from common features, even as we see that the later one greatly exceeds the earlier in

terms of technological know-how. Inductive inferences are, by their nature, probabilistic, and do not need to be perfect to be useful in science. However, science has advanced from Hume's day, with the discovery of machine-like biochemical motors in the cell showing much closer analogies to man-made artefacts.¹⁷

So, induction is not absolute in terms of explanatory power, but that is no reason to say it is of no value. This does, however, lead to the possibility of competing explanations. One is then forced to choose which is the best explanation—this is what we call abduction. A number of philosophers, such as Elliott Sober, have pointed out that the design argument can be framed as an inference to the best explanation (although, like Mackie, Sober believes that intelligent design fails in terms of testability).^{17,18}

Mackie also suggests that the designer need not be the God of the Bible,² and it is notable that Hume outlines other possible mystical designers in Part VII (as discussed above). Erasmus Darwin in fact asserts that it was Hume's intention to inform us that there is an esoteric power of generation in nature, what Darwin called the maker of the machine.

“The late Mr. David Hume, in his posthumous works, [Dialogues] places the powers of generation much above those of our boasted reason; and adds, that reason can only make a machine, as a clock or a ship, but the power of generation makes the maker of the machine... increasing by the activity of its inherent principles, rather than by a sudden evolution of the whole by Almighty fiat.—What a magnificent idea of the infinite power of THE GREAT ARCHITECT!”¹⁹

Erasmus Darwin here compares special creation, which he refers to as “sudden evolution ... by Almighty fiat”, against Hume's power of generation—which is essentially a belief in gradual evolution by esoteric forces. Like Hume, Erasmus Darwin suggested that the formation of the mythological goddess Aphrodite (the Roman Venus) provided an allegory

for gradual evolution—we might think of this as pantheistic evolution by an impersonal divine agent.²⁰

In response to Mackie's claims, it is hard to believe that such impersonal esoteric forces of chaos and generation, even acting over eons of time, could lead to the beauty and order we see in the world. Intelligent design provides the more coherent and far better explanation. Philo's arguments, involving two positions, also reveal the equivocation in the concept of nature. Just as Hume strongly divided two Christian perspectives, he arguably tried to hold together pantheism and atheism through the character Philo. To put it another way, nature is said to be ‘all-there-is’, but at the same time it is ascribed divine properties in terms of a mystical self-creating and self-sustaining power, and also providing its own ground for truth. Sometimes it is personified as ‘mother nature’; at other times the personification disappears. Hume's work points to the conclusion that within naturalism there is a latent pantheism, and religious neutrality, so loved by secular humanists, may be an impossible dream.²¹

Conclusion

Overall, Hume's arguments do not undermine the design inference. The analogy to human intelligence remains a strong one, not a weak one, and is certainly stronger than Hume's appeal to Greek mythology. However, because of the nature of inductive inferences, it is necessary to choose the best explanation among alternative ones. Intelligent design holds up very well against naturalistic, evolutionary ones. Hume, through his character Philo, reveals that belief in gradual evolution utilizes an equivocation: that is, between the belief that nature is ‘all there is’ and the belief that it also possesses a mystical power of generation.

The division between Demea and Cleanthes in *Dialogues* highlights an unhealthy division for Christians. Believers



Figure 3. Do inferences to design have to be perfect to be useful? Here are two cars produced by Ford, The Model T (left) from 1925, and the Ford Focus (right) from 2019. We can infer common design, even though the car on the right is more complex than the one on the left.

should not strongly divide the presuppositional from the evidentialist arguments as Hume has done. Even as we can recognize the priority of faith for the believer, we can also acknowledge that evidence coheres with prior faith commitments. Finding coherence between evidence and Christian beliefs and doctrines is the methodology followed by biblical creationists. There are salutary lessons for theologians and intelligent design proponents here. There is a danger in overstating each side of the argument. The pure presuppositionalist position looks like fideism and may elevate God so highly that he becomes unknowable. On the other hand, the pure evidentialist position may lead to deism, where God is removed to a distant past, or reduced to a human watchmaker, where ongoing divine providence becomes unnecessary. Each error may ultimately lead to atheism. But God has revealed Himself to us in the form of the incarnate Jesus Christ, the archetype for Adam's race, which is created in His image. A further important doctrine is the Fall, which avoids a rather immature approach to design.

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Developments in paleoanthropology no. 3

Peter Line

This paper discusses some of the more interesting fossil finds and/or developments in paleoanthropology from a creationist perspective. This includes new dates for the Sterkfontein *Australopithecus* fossils from South Africa, the identity of the Red Deer Cave people from China, bipedalism in gibbons, and developments in the *Australopithecus sediba* mandibular ramus dispute. An update on the controversial *Sahelanthropus tchadensis* femur is also given. Also discussed is the finding that *Homo naledi* likely used fire.

New dates for Sterkfontein *Australopithecus* fossils

On 27 June 2022 Granger *et al.* published new dates for the Sterkfontein *Australopithecus* fossils from South Africa.¹ They used a method known as Cosmogenic Nuclide Burial Dating.² In a nutshell:

“The new ages are based on the radioactive decay of the rare isotopes aluminum-26 and beryllium-10 in the mineral quartz. ‘These radioactive isotopes, known as cosmogenic nuclides, are produced by high-energy cosmic ray reactions near the ground surface, and their radioactive decay dates [from] when the rocks were buried in the cave when they fell in the entrance together with the fossils,’ says Professor Darryl Granger of Purdue University in the United States and lead author on the paper.”³

This technique had earlier been used to date the Sterkfontein *Australopithecus* Little Foot skeleton (StW 573) to allegedly 3.7 Ma (million years ago).⁴ This date was subsequently disputed, with Pickering *et al.* suggesting a date of around 2.8 Ma “or possibly even more recent”.⁵ The Little Foot skeleton has been assigned to the species *Australopithecus prometheus* by its discover, Ronald Clarke,⁶ but it is likely just a variant of *Australopithecus africanus*.⁷ The date of Little Foot, along with the new dates for the other *Australopithecus* fossils (including *Australopithecus africanus*; see figure 1), yielded a combined range of supposedly about 3.4 to 3.7 Ma for the entire *Australopithecus* assemblage at Sterkfontein.⁸ This was allegedly a million years or so older than the ages, of about 2.1 to 2.6 Ma, attributed previously to most of the newly dated fossils (from Member 4).⁹ These ages are said to be determined from U-Pb and paleomagnetism dating of flowstones that Granger *et al.* believe are “stratigraphically intrusive within Member 4 and that they therefore underestimate the true age of the fossils.”⁹

The new age range overlaps with *Australopithecus afarensis* fossils (e.g. Lucy) and other alleged ‘hominins’ from East Africa and Chad.² Lucy’s species (*Australopithecus afarensis*) was long alleged to have been the prime

contender for the ancestor of the human lineage.¹⁰ Now, the Sterkfontein *Australopithecus* assemblage competes with the East African ‘hominins’, particularly *Australopithecus afarensis*, as ancestors of later supposed hominins, including the genus *Homo*.¹¹ Basically, it is a competition between *Australopithecus africanus* and *Australopithecus afarensis*. However, from a creationist viewpoint, these and other australopithecines were not part of any evolutionary lineage, rather they were just part of a group of extinct apish primates, as explained in detail elsewhere.¹²

On how to resolve disagreements between different research teams on the ages of the Sterkfontein fossils, Charles Choi writes (quoting paleoanthropologist John Hawks):

“For example, scientists who want to solve the puzzle of the ages of these bones may take part in double-blind experiments involving ‘different groups of researchers examining the same samples, without knowing where they are from until they report their results,’ Hawks said. ‘Otherwise, there is too much potential for researchers to choose samples and methods that reinforce their own ideas.’”¹⁰

One wonders how many ages reported in the literature were selected because they reinforced the ideas of the researchers. Redating of fossils is not a rare occurrence. The new dates discussed above illustrate the fickle nature of age estimates obtained from dating methods.

Red Deer Cave people identified

In 2012, a study was published on the fossil remains, from Maludong (Red Deer Cave) and Longlin Cave in Southwest China, of what were dubbed the Red Deer Cave people.¹³ The human remains from the two localities were dated between allegedly ~11.5 and 14.5 ka (thousand years ago).¹⁴ The study was said to be “principally based on the remains of at least three individuals from Maludong”, which were excavated in 1989, as well as a partial skeleton from Longlin, discovered in 1979.¹⁵ Unusual features of the Red Deer Cave people



Photo by Peter Line

Figure 1. Cast of the Sts 5 *Australopithecus africanus* cranium (nicknamed Mrs Ples) from Sterkfontein, South Africa. Its new geological age is supposedly around 3.4 Ma.

included “a flat face, a broad nose, a jutting jaw that lacked a chin, large molar teeth, a rounded braincase with prominent brow ridges, and thick skull bones”.¹⁵ According to the analysis of the researchers, two plausible explanations for the morphology of the Red Deer Cave people were suggested:

“First, it may represent a late-surviving archaic population, perhaps paralleling the situation seen in North Africa as indicated by remains from Dar-es-Soltane and Temara, and maybe also in southern China at Zhirendong. Alternatively, East Asia may have been colonised during multiple waves during the Pleistocene, with the Longlin-Maludong morphology possibly reflecting deep population substructure in Africa prior to modern humans dispersing into Eurasia.”¹⁶

The study team were reluctant to call their find a new species, and other paleoanthropologists were skeptical the announced fossil human was evolutionarily unique or a new human group, which is likely why the *National Geographic* article had the ambiguous title: “Cave Fossil Find: New Human Species or ‘Nothing Extraordinary’?”.¹⁵

In late 2013 further analysis of the Maludong remains, including additional human cranial remains, were said by the researchers to “strengthen the affinities of the Maludong remains to archaic humans.”¹⁷ They wrote that:

“It seems unlikely that the Maludong remains simply represent very robust members of a late Pleistocene modern human population, perhaps people who acquired their

archaic features through evolutionary reversal owing to isolation and random genetic drift.”¹⁸

Although the authors refrained from classifying the Maludong remains, they stated that “The most plausible scenario at present seems to be that the Maludong fossils along with those from Longlin cave ... might represent a late surviving archaic population.”¹⁸

In July 2015, members of the research team published a paper further examining the Longlin 1 (LL 1) cranium (figure 2), in particular its shape, and concluded that “a scenario of hybridization with archaic hominins best explains the highly unusual morphology of LL1, possibly even occurring as late as the early Holocene.”¹⁹ Then, in December 2015, a femur from Maludong was described that they said “probably samples an archaic population that survived until around 14,000 ka ago in the biogeographically complex region of South-

west China.”²⁰ Team co-lead, Darren Curnoe, in an article in *The Conversation*, stated:

“Our work shows that the thigh bone strongly resembles very ancient species like early *Homo erectus* or *Homo habilis*, which lived around 1.5 million years ago or more in Africa.”²¹

Curnoe also noted that they were now treating the Longlin specimen as a “separate group, distinct from the bones from Red Deer Cave, or Maludong, and one that we now think is indeed very likely to be a hybrid.”²¹ Curnoe finished the article asking questions about the Red Deer Cave people, including “Just who exactly were these mysterious Stone Age people?”²¹ He also asked:

“What did modern humans make of them? And how did they interact with them when they encountered them? Did they interbreed with them?”²¹

Several years later answers to questions about the Red Deer Cave people were forthcoming, but perhaps not in the way expected by the researchers. It turns out they were modern humans. The team (Curnoe was not an author this time) published the results of an ancient DNA (aDNA) study in July 2022, where they reported on the genome sequencing of aDNA extracted from the calotte (skullcap) of a female Maludong specimen (MLDG-1704).²² According to the authors, their results indicated that MZR (the ‘Late Pleistocene hominin’ sequenced, i.e. MLDG-1704) “is a modern human who represents an early diversified lineage in East Asia.”²³ They further wrote that:

“MZR also shows a deep and indirect link to the ancestry that contributed to First Americans, which may help reconstruct the earliest migratory route from East Asia to the Americas.”²⁴

An article on the study from *Cell Press* stated:

“From the cave, researchers recovered a hominin skull cap with characteristics of both modern humans and archaic humans. For example, the shape of the skull resembled that of Neanderthals, and its brain appeared to be smaller than that of modern humans. As a result, some anthropologists had thought the skull probably belonged to an unknown archaic human species that lived until fairly recently or to a hybrid population of archaic and modern humans.”²⁵

One thing that can be learnt from the Red Deer Cave people saga is that humans should not be categorized as belonging to different human species based on morphological traits considered ‘archaic’. We know that Neanderthals and the mysterious Denisovans interbred with each other and with modern humans,²⁶ so these groups also belong with *Homo sapiens*. No aDNA has up to now been successfully sequenced from the so-called ‘archaic’ humans categorized as *Homo erectus*, but why should not these people also be categorized as *Homo sapiens*? It may well be the case that humans categorized as *Homo erectus* are Denisovans.

Bipedalism in gibbons

I have previously pointed out the logical fallacy that evolutionists engage in when they equate bipedal features in fossil primates in Africa, such as the australopithecines, with necessarily being a hominin (i.e. an apeman).²⁷ One justification for this criticism is the finding (from fossils) that apes/primates in Europe were likely built for some form of bipedalism and/or upright posture yet are not considered hominins.²⁸ Why, then, would bipedal features in the australopithecines from Africa mean they were hominins?

The Bible does not address the issue of locomotion in primates, and so, from a creation viewpoint, if bipedal ape-like primates existed, it does not contradict Scripture. If God created humans bipedal, why would He not use variation on a similar design pattern for some other primates? Given how many non-human primates there are, if considering both extant and extinct species, it would in some ways seem a bit unusual if He had not. Hence, to the extent they were bipedal (which seems to have differed significantly from human-like bipedality), the australopithecines were likely one such primate group.

In the above context it is relevant mentioning that the lesser apes, the gibbons (Hylobatids; see figure 3), are apparently more bipedal than any of the great apes, which

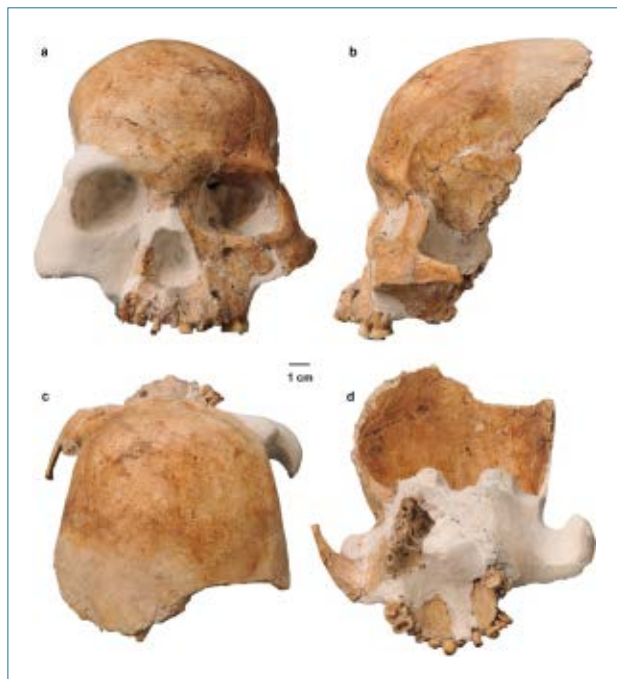


Figure 2. Longlin 1 cranium, Southwest China. (a) anterior view, (b) left lateral view, (c) superior view, and (d) inferior view.

Image: Darren Curme, Xueping Ji, Paul S. Tacon, and Ge Yaozheng / Wikimedia / CC BY-SA 4.0

are supposedly closer to humans on the evolutionary tree.²⁹ According to Rosen *et al.*:

“Yet, we also cannot ignore these data demonstrating that hylobatids—the only primates in our study with a long lumbar region and an orthograde body posture, essential characteristics for upright walking in humans ... —practice bipedal locomotion more frequently and for longer distances than the other non-human primates ... ”³⁰

The authors also stated:

“These lines of evidence tentatively indicate that humans and hylobatids reflect the ancestral body form with respect to lumbar mobility and positional behaviour If true, then the short, stiff lumbar regions and correlated terrestrial knuckle-walking locomotion evolved in parallel in Pan and Gorilla as some have hypothesised”³¹

Hence, if humans and gibbons have more in common with each other, in terms of upright posture and bipedalism, than they have with great apes like chimps, then that seems to make a very messy evolutionary scenario even more untenable.

Australopithecus sediba mandibular ramus update

A study by Rak *et al.*, of the mandibles belonging to the two partial *Australopithecus sediba* skeletons (MH1 and MH2), concluded that “the specimens represent two separate genera: *Australopithecus* and *Homo*.”³² As discussed in an

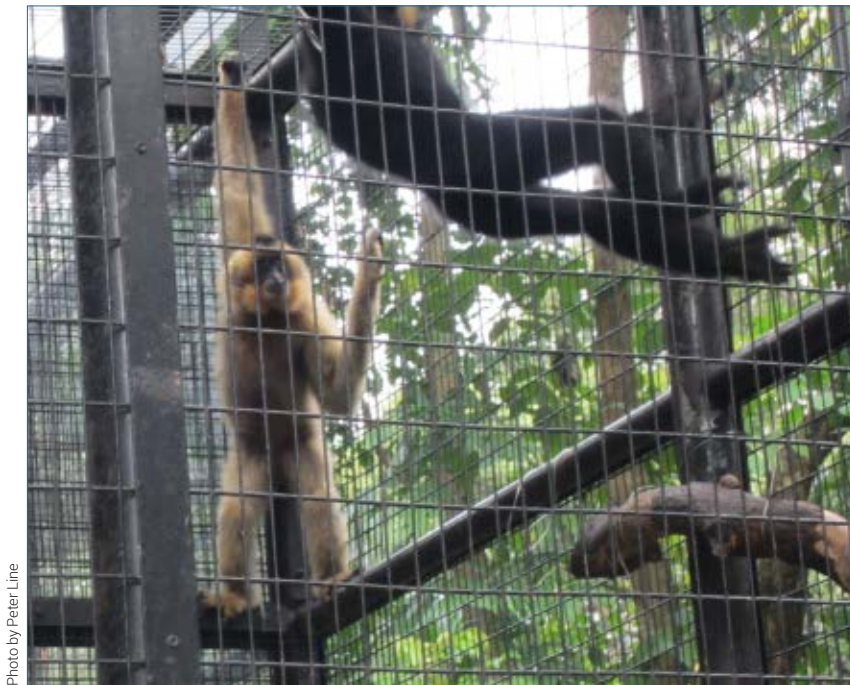


Photo by Peter Line

Figure 3. A Buff-cheeked Gibbon in captivity.

earlier article, the aspect of the mandibles examined was the upper ramal morphology, mainly the shape of the mandibular notch between the condylar process and coronoid process.³³

In response to this, Hawks and Berger later published an article where they highlighted “other fossil samples that show the same pattern of mandibular ramus variation as observed in MH1 and MH2.”³⁴ This included mandible fossil samples from the genus *Homo*,³⁵ likely of the same group and ‘species’ (whether *Homo heidelbergensis* or *Homo erectus*). According to the authors, the widespread variation of the ramus features used “makes them unsuitable to be used for taxonomic diagnosis on their own.”³⁶

***Sahelanthropus tchadensis* femur update**

The Toumaï cranium, assigned to the species *Sahelanthropus tchadensis* and promoted in 2002 as the earliest known hominin, in my assessment appears to have belonged to an extinct ape/ape-like primate, with claims of bipedalism unsubstantiated.³⁷ From an evolutionary perspective a hominin is a species that is more closely related to humans than to chimpanzees.³⁸ I earlier discussed a study (Macchiarelli *et al.*³⁹) on a femur that may have belonged to *Sahelanthropus tchadensis*, and how, even from an evolutionary viewpoint, it poured more doubt on claims that *Sahelanthropus tchadensis* was bipedal and a hominin.⁴⁰ Since then, a different research team published a study on the same femur, as well as two ulnae, all likely associated

with *Sahelanthropus tchadensis*. This species was said to be the only ‘hominin’ species identified in that location (TM 266), although it was also stated that “none of these limb bones can be reliably ascribed to any hominin craniodental specimen found at TM 266”⁴¹ (e.g. the Toumaï cranium). In summary, Daver *et al.* concluded:

“The morphology of the femur is most parsimonious with habitual bipedality, and the ulnae preserve evidence of substantial arboreal behaviour. Taken together, these findings suggest that hominins were already bipeds at around 7 Ma but also suggest that arboreal clambering was probably a significant part of their locomotor repertoire.”⁴¹

Writing on the find in *Nature*, Daniel Lieberman points out that a resolution on the bipedal status of *Sahelanthropus* is not yet forthcoming:

“... because the femur consists mostly of a shaft that doesn’t have the joints at either end ... that would provide most of the information needed to infer *Sahelanthropus*’s posture and how it walked.”⁴²

Lieberman commented that the authors of the study had “squeezed as much information as possible from the fossil data, focusing on features that they suggest are consistent with bipedalism.”⁴² However, Lieberman acknowledged that the “*Sahelanthropus* femur doesn’t have ‘smoking-gun’ traces of bipedalism, but it looks more like that of a bipedal hominin than that of a quadrupedal ape.”⁴²

Some evolutionary paleoanthropologists are not convinced that *Sahelanthropus* was a bipedal hominin. In an online *Nature* article Ewen Callaway quotes Bernard Wood as saying: “They cherry-pick what they think is information which is consistent with the femur shaft being a biped, and they studiously ignore information to the contrary.”⁴³ Roberto Macchiarelli, the first author of the earlier study of the *Sahelanthropus* femur, still thinks it more likely *Sahelanthropus* was an ape than a hominin.⁴³ Clare Wilson, writing for *New Scientist*, wrote in regard to Macchiarelli’s views on *Sahelanthropus*:

“But Macchiarelli isn’t convinced. This is partly because he says the angle the femur makes with the pelvis would be ‘mechanically unstable for a vertical stance’. Other primates that mainly walk on four legs occasionally stand up and walk on two, which could be why *S. tchadensis* has some features of bipedalism, says Macchiarelli. ‘There’s a bipedal signal in any primate,’ he says.”⁴⁴

Daver *et al.* made the following interesting comment:

“The multiplicity of attested and presumptive bipedalities currently proposed for several phylogenetically distinct hominoid taxa (for example, *Orrorin*, *Ardipithecus*, *Australopithecus*, *Danuvius* and *Oreopithecus*) strongly suggests that searching for a unique defining trait of bipedalism is hazardous (‘magic trait’ sensu ...).”⁴⁵

The reality is that the finding of traits of bipedalism in several different extinct apes and/or primates that are not regarded as ‘hominins’ (e.g. *Danuvius* and *Oreopithecus*), and even in living apes, if gibbons are included in this category (see above), nullifies bipedal traits in fossil bones of extinct primates as evidence that they were supposed hominins. Lieberman states that the idea that “bipedalism evolved more than once among apes is thought by many to be unlikely.”⁴² I would add that bipedalism could not even have evolved once, given the complexities involved. The only way you can explain traits of bipedalism in different primates is by intelligent design.

Hence, regardless of the bipedal status of *Sahelanthropus tchadensis*, or lack thereof, it was simply an extinct ape/ape-like primate, not a hominin, the latter existing only as an evolutionary construct.

***Homo naledi* used fire**

After promising a major announcement with respect to *Homo naledi* on 1 December 2022, paleoanthropologist Lee Berger, in a Carnegie Science talk, delivered.⁴⁶ He presented evidence for the use of fire in the Rising Star cave system, South Africa. The only supposed hominin remains known to have been found in this cave system are those attributed to *Homo naledi*. Hence, it is likely they were the users of fire. Berger believes *Homo naledi* individuals were the users of fire in the cave system, but he regards *Homo naledi* as a “truly non-human species.”⁴⁶

It was only after Berger lost enough weight (over 23 kg (50 lb)), allowing him for the first time to make it into the Dinaledi Chamber of the Rising Star cave system, that evidence for the use of fire was discovered. As told by Debora Patta:

“I looked up. And I realized the ceiling was black.

It was burnt. It was covered in soot. It had been right



Photo by Peter Line

Figure 4. 3D print of the skull from the LES1 *Homo naledi* partial skeleton (nicknamed Neo). 3D Data made available by the Evolutionary Studies Institute, University of the Witwatersrand.

above our heads the entire time,’ Berger said of his discovery.”⁴⁷

Patta continued to write:

“It’s undeniable evidence of fire. The same day, lead investigator and paleoanthropologist Keneiloe Molopyane was making another remarkable find nearby: ‘Pieces of bone ... burnt bone’, she said, which indicated they were eating there.”⁴⁷

In the Lesedi chamber (where the Neo skeleton was found; see figure 4), as described by Sethchagi, the team “found burned rocks, with ashes at the bottom, and even further in, there was an abundance of burnt bone of small animals, and yet no signs of stone tools at all.”⁴⁸

According to the Bradshaw Foundation *Homo naledi* page:

“The expedition soon found evidence of fire use throughout the many passages and chambers, even within the most remote recesses of the cave system. Charcoal, ash and burnt bones had gone unnoticed in some chambers, as well as soot blackening on walls and ceilings. As Lee has commented, ‘We had blinded ourselves by thinking that evidence of fire was not there, but once our eyes were opened, the evidence for fire throughout the system wasn’t difficult to see at all, it was everywhere.’”⁴⁹

According to Berger,

“Everywhere there is a complex juncture, they built fire. Every adjacent cave system to the chambers where

we believe they were disposing of the dead, they built fire and cooked animals, and in those chambers where they disposed of the dead, they brought fire but didn't cook animals".⁴⁶

So, does the finding that *Homo naledi* likely used fire affect current interpretations of this species? I have discussed the *Homo naledi* finds in much more detail elsewhere.^{50,51,52,53} My interpretation of *Homo naledi* was that it likely consisted of *Homo erectus*-type 'robust' humans (descendants of Adam and Eve), some of whom suffered from a developmental pathology called cretinism. This could possibly explain some of the odd morphological features present in some of the fossil specimens. As such, nothing changes from my perspective. Rather, if they used fire, they were undoubtedly fully human. It need not necessarily have been the pathological individuals that used fire, but the healthier ones. If indeed they used fire, it makes it difficult to argue from a creation viewpoint that they were not fully human. Evolutionists in general believe *Homo naledi* to be a non-human species. If *Homo naledi* used fire to navigate the Rising Star cave system, as well as to cook food, then they will have to admit that it was much more intelligent than many had assumed.

There are issues that are of interest to both creationists and evolutionists. Particularly so is the date of the charcoal. In the talk Berger said they had previously dated charcoal from the Lesedi chamber (two pieces lying on the surface), and it "had given very young dates", but the context was said to be terrible.⁴⁶ What happens if they use radiocarbon dating on charcoal directly associated with the use of fire by *Homo naledi* and it gives a very young age? Will they then say that the young age was proof of contamination, or that *Homo naledi* was not the fire maker, or accept the result at face value?

According to Alison George, "Dating of the charred remains is still underway, so the decision to announce the fire discovery in a talk on 1 December, prior to the publication of the formal scientific analysis, has proved controversial."⁵⁴ Writing in *The Washington Post*, Mark Johnson gave the view of a past critic of Berger's, paleoanthropologist Tim White, on the latest announcement:

"White said rigorous studies must date both the evidence of fire and the *H. naledi* [sic] bones if Berger's team is to demonstrate that both come from the same period. Other studies must show not just the presence of fire, but its controlled use. Testing would need to establish that the material believed to be soot actually is soot and not discoloration caused by chemicals or other factors."⁵⁵

As stated by Johnson,

"Berger acknowledged that one of the major challenges facing him and his colleagues will be dating the materials they've found. So far, they've said the *H. naledi* [sic] bones date to between 230,000 and 330,000

year [sic] ago, though Berger stressed that those dates should not be viewed as the first or last appearances of the species."⁵⁵

Concerning implications of the find, George writes that, "For Berger, the fire-use discovery has implications that are even more revolutionary. If these small-brained humans with many primitive features were capable of the complex cognition required to make and control fire, then 'we're beginning to see the emergence of a cultural pathway and behaviour that we thought, until this moment, was the domain of [*Homo sapiens* and Neanderthals],' he says."⁵⁴

Berger has promised further big announcements, so there is sure to be a lot more to come on *Homo naledi*.

Conclusions

From an evolutionary viewpoint, the Sterkfontein *Australopithecus* assemblage, after being assigned new dates, now competes with the East African 'hominins', particularly *Australopithecus afarensis*, as ancestors of later supposed hominins, including the genus *Homo*.

Rather than belonging to an unknown 'archaic' human species, or hybrid population of 'archaic' and modern humans, it turned out that the Red Deer Cave people from China were modern humans, as indicated by an aDNA study. The Red Deer Cave people saga cautions against categorizing humans as belonging to different human species based on morphological traits considered 'archaic'.

If humans and gibbons have more in common with each other, in terms of upright posture and bipedalism, than they have with great apes like chimps, then that seems to make a very messy evolutionary scenario even more untenable.

The apparent widespread variation of ramus features in mandibles appears to make them unsuitable as a taxonomic diagnostic tool on their own.

The bipedal status of *Sahelanthropus tchadensis* is still doubted by some evolutionists, even after evidence in favor of bipedal features in its femur was published. Regardless of its bipedal status, or lack thereof, it was simply an extinct ape/ape-like primate, not a hominin, the latter existing only as an evolutionary construct.

If indeed *Homo naledi* used fire, it makes it difficult to argue from a creation viewpoint that they were not fully human. In other respects, the find raises new questions, such as the age of charcoal directly associated with fires attributed to *Homo naledi*.

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Hydroplate Theory energy budget falls short of expectations

Robert W. Carter and Edward A. Isaacs

As a model for the biblical Flood, Hydroplate Theory (HPT) claims to account for many features across Earth and the solar system. However, no energy budget has yet been put forward for HPT. Since HPT begins with a world-encompassing shell of granite sitting above a subterranean shell of water, essentially all the initial energy is stored as gravitational potential energy. From this stored energy, HPT must account for the formation of asteroids, comets, and trans-Neptunian objects. Exotic energy sources fail to account for HPT's limited energy budget. Thus, gravitational potential energy must account for essentially all the work done, especially during the first 40 days of the Flood when the fountains of the deep supposedly ejected massive amounts of material into space. However, even assuming no losses due to energy conversion, the energy required to lift the objects to the asteroid belt far exceeds the available energy, while trans-Neptunian objects would require energy levels exceeding five orders of magnitude greater than the available energy. The energy to create comets, TNOs, and asteroids is simply not available. Energy budget considerations invalidate this part of HPT.

In his book *In the Beginning: Compelling Evidence for Creation and the Flood*,¹ Dr. Walter Brown presented a controversial model of the Flood known as the Hydroplate Theory (HPT). Revised through multiple editions over several decades, Brown's current model proposes an antediluvian Earth quite different from that of today. This Hydroplate Theory Earth would have been constructed of a worldwide shell of granite approximately 100 km thick² overlying a subterranean layer of water approximately 1.6 km thick,³ both of which rested upon a solid basalt mantle. Because the granite crust was warped into 'pillars', similar to a 3D sinusoid, the minima of which were in contact with the basalt basement, the subterranean water chamber was an intricately interconnected network of passageways. But it may still be modelled as a simple shell for most purposes.

According to HPT, the waters beneath the crust were initially in the liquid state. Tidal pumping gradually increased the pressure in the subterranean chamber until the trapped waters became supercritical. This is said to have occurred soon after creation. Importantly, the entire system had to remain in isostatic equilibrium, with the tremendous downward pressure of the granite shell being balanced by a combination of highly pressurized supercritical water and the supporting effects of the pillars. Supercritical water only exists at extreme temperatures and pressures (figure 1). It is unlike liquid water in many respects and is especially sensitive to large changes in density with small fluctuations in pressure or temperature. It is highly compressible, so it is an open question how liquid water could transition into supercritical water without collapsing the overlying HPT crust. It is also unknown how a specific density was

maintained for centuries while in the supercritical state. Yet, somehow, isostatic balance was maintained for about 1,600 years until the Flood began. Brown claims that tidal pumping from the moon added much energy to the system over time, counteracting the expected heat loss to the surface:

"However, a fraction of that energy was dissipated as heat and would have maintained the subterranean water's supercritical temperature that was established as the foundation of the Earth's crust was established during the creation week."⁴

We will put aside the question of how the underground water could have gone through such a phase transition without cracking the overburden of rock, or how the energy input from tidal pumping could have exactly balanced heat loss. Instead, we will begin our discussion with the situation immediately prior to the Flood.

Under HPT, crustal failure at the Flood's initiation generated supersonic water jets, eroding the edges of the upper crust and a smaller portion of the underlying basalt along the edges of today's mid-ocean ridges. As it fell back to earth, this water is proposed to be the source of the 40 days of rain at the beginning of the Flood. The rock that was eroded from the fracturing granite crustal fragments (hydroplates) is said to have become the source of the sediments comprising the rock record. As this granitic crust was removed along the fissures above the chamber floor, an elastic rebound of the basalt mantle uplifted and created the mid-ocean ridges. Beginning with the uplift of the Mid-Atlantic Ridge, the resulting slope propelled the continental plates downhill, lubricated by the remaining underground waters, until the water ran out and the continents came to

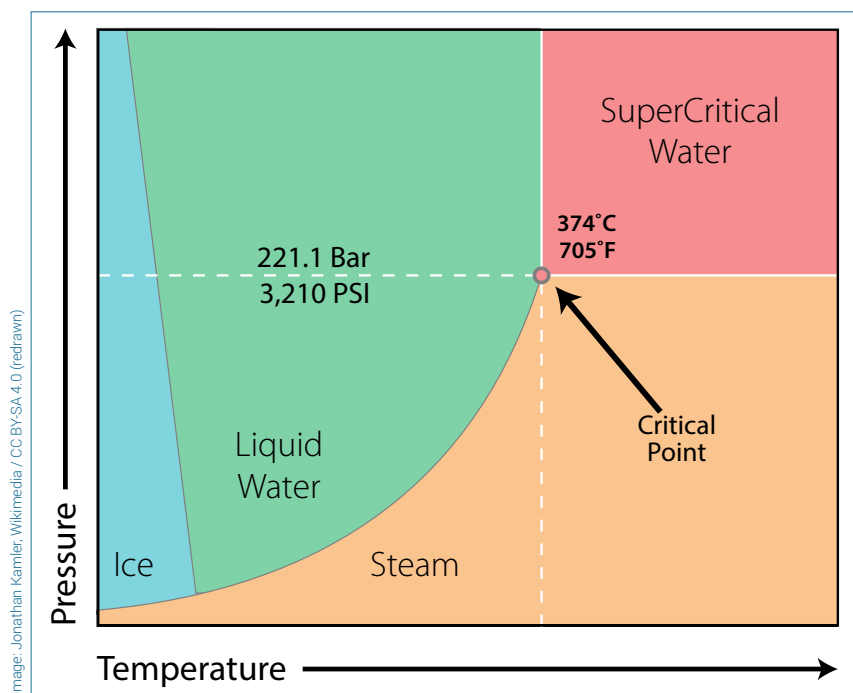


Figure 1. Due to the tremendous confining pressures and high temperatures, HPT's subterranean water chamber is thought to have become supercritical, a phase where solid, liquid, and gas exist contemporaneously in a dynamic equilibrium.

rest in their current positions. The grinding halt is thought to have raised mountain chains worldwide, during the so-called Compression Event. This would have started the recession of floodwaters from the continents, beginning on day 150.

With the current continents representing only a fraction of HPT's postulated primordial granite shell, HPT proposes that most of this granite shell is to be found not on Earth but throughout the solar system as asteroids, comets, and trans-Neptunian objects (TNOs⁵). As Brown states:

"All along this globe-circling rupture, whose path approximates today's Mid-Oceanic Ridge, a fountain of water jetted hypersonically into and far above the atmosphere. ... The most powerful jetting water and rock debris escaped Earth's gravity and became the solar system's comets, asteroids, and meteoroids."⁶

Furthermore:

"The fountains of the great deep launched rocks as well as muddy water. As rocks moved farther from Earth, Earth's gravity became less significant to them, and the gravity of nearby rocks became increasingly significant. Consequently, many rocks, assisted by their mutual gravity and surrounding clouds of water vapor that produced aerobraking, merged to become asteroids. Isolated rocks in space are meteoroids. Drag forces caused by water vapor

and thrust forces produced by the radiometer effect concentrated most smaller asteroids in what is now the asteroid belt. Larger asteroids were acted on longer by more powerful forces which pushed them out beyond Neptune's orbit. All the so-called 'mavericks of the solar system' (asteroids, meteoroids, comets, and trans-Neptunian objects) resulted from the explosive events at the beginning of the flood."⁷

Simply put, Brown proposes that asteroids, comets, and TNOs are the leftover crustal fragments ejected by the supersonic water jets during the first 40 days of the Flood.⁸ This raises serious questions regarding the energy available within the earth system to generate such wide-ranging changes to the solar system. We will ignore the fact that Earth's gravity is irrelevant when considering mutual attraction

of small orbiting bodies. Also, given the sheer volume of space into which this material was sent, we wonder how much 'aerobraking' could possibly have occurred. Plus, increased drag would cause any circulating particles that were initially injected into an orbital pathway to slow and thus plunge more quickly into the sun. We also wonder why this process favoured two specific regions (the Asteroid Belt and trans-Neptunian space) only. These, however, are questions for some future critique of HPT.

Though several studies have examined HPT predictions in light of geological expectations,⁹⁻¹² the question of an energy budget for HPT's proposed formation of comets, asteroids, and TNOs remains to be explored. The purpose of this paper is to examine the energy budget of the HPT Earth system as a test point for HPT's viability.

Modelling the HPT Earth System

Using Brown's proposed chronology of the Flood, the HPT Earth System may be modelled using the following conditions (figure 2):

1. The subcrustal radius of the HPT Earth would have been 290 km greater than Earth's observed radius of 6,378 km, believed to be due to shrinkage of the mantle to form Earth's core around day 150 of the Flood.¹³ This raises Earth's subcrustal radius to 6,668 km.

2. A 1.6-km shell of water and an overlying 100-km shell of granite crust sat atop Earth's solid basalt mantle, 6,668 km from Earth's centre. Thus, Earth's surface would average 6,770 km from its centre.

At the most basic level, the system is driven by gravitational potential energy (GPE). Additional potential energy sources will be discussed below, but the focus here is on gravitational energy only. We will also assume the gravitational field is a constant for two reasons: Earth's radius is much greater than the maximum vertical displacement of the HPT crust (1.6 km), and any potential loss of mass from the system is necessarily much less than Earth's total mass. In the calculations and discussion below, all results will be reported to three significant figures.

Methods

Step 1: Calculate the volume of the HPT outer granitic crust

Using the nested spheres approach, the volume of a spherical shell is simply the volume of the larger sphere minus the volume of the smaller sphere, or $4/3\pi(R^3 - r^3)$.¹⁴ Given a starting radius of 6,770 km, which includes 100 km of upper crust and a 1.6-km-thick internal shell of water, the HPT crust has a volume of $5.67 \times 10^{10} \text{ km}^3$. Assuming granite is incompressible, any pillar material within the 1.6-km-thick subterranean chamber has zero GPE. This would displace an unknown amount of water, however, which would reduce the total available energy of the system. Nonetheless, we shall ignore the presence of granite pillars, which would reduce the GPE of the system and treat the granite crust as a simple shell.

Step 2: Calculate the mass of the outer crust

The average density of granite is 2.67 g/cm^3 , giving the HPT outer crust a mass of $1.52 \times 10^{23} \text{ kg}$.¹⁵

Step 3: Calculate GPE

Gravitational Potential Energy is simply mgh . Therefore, GPE for the granite shell is $2.38 \times 10^{27} \text{ joules (J)}$.¹⁶ Note that this value represents an upper limit to the available energy derived from GPE as it does not account for energy lost to friction as the granite shell fractured, heated the surrounded area, and other factors.

A convenient measure is found by normalizing this to the outer surface area of the antediluvian HPT Earth: $4.13 \times 10^{12} \text{ J/m}^2$.¹⁷

Step 4: Calculate the energy required to raise a mass to some level above the earth's surface

There are multiple ways to perform this calculation. The simplest is to understand that the escape velocity of the earth is 11.2 km/s and that kinetic energy is $\frac{1}{2}mv^2$. To accelerate a 1 kg mass to that velocity requires $6.27 \times 10^7 \text{ J}$, but this is for Earth's current radius and mass. Within HPT, even after much of the original crustal material has been ejected, the total mass of the earth ($5.97 \times 10^{24} \text{ kg}$) would not be affected (to three significant figures). The radius change, however, does have an effect.

A more general formula to use for this calculation is $U = -Gm_1m_2/r$, where U is the gravitational potential energy in joules. This is the energy loss involved in an object of mass m_1 falling from an infinite distance to distance r from another object of mass m_2 . G is the gravitational constant ($6.67 \times 10^{-11} \text{ m}^3/\text{kg}\cdot\text{s}^2$). In this case, the amount of energy required to reach escape velocity from the antediluvian HPT earth is $5.88 \times 10^7 \text{ J/kg}$.¹⁸

Yet, Earth's escape velocity is only part of the problem. It takes much more energy to raise an object in the sun's gravity well than to escape the gravitational bounds of Earth, even when starting at 1 AU (the average distance of the earth to the sun, $1.50 \times 10^8 \text{ km}$). Using $1.99 \times 10^{30} \text{ kg}$ for the mass of the sun, to move a 1 kg mass from the radius of Earth's orbit (1 AU) to the average distance between Haley's Comet and the sun (18.3 AU) would require $8.39 \times 10^8 \text{ J}$,¹⁹ or 14 times more energy than the energy required to reach the earth's escape velocity.

Combining these, it takes $8.98 \times 10^8 \text{ J}$ of energy to raise a 1 kg mass from the surface of the earth to the orbit of Haley's Comet. We can conclude that each kilogram of crustal rock propelled to that distance would use up the potential energy of 2.17 cm^2 of the HPT crust. We can ignore the fact that comets are supposed to have coalesced from small particles. The same amount of mass must still be ejected. Yet, this is only the final mass. Many small particles would be expected to be lost after being pushed out of the solar system by the solar wind or captured by the sun or Jupiter. Thus, this is a best-case calculation.

Results

The energy required to launch a projectile with the mass of Haley's comet ($\sim 2.20 \times 10^{14} \text{ kg}$) to its average orbital distance²⁰ from the sun equates to $1.97 \times 10^{23} \text{ J}$. This would use up the GPE of $4.78 \times 10^{10} \text{ m}^2$ (4,780 km^2), or 0.83% of the earth's surface. At present, approximately 100 Haley-type comets are known to exist. These would take up nearly all of the available GPE alone, but there are many other

comets in various categories. If any of these originate on Earth, they must be accounted for in the energy budget.

To account for the mass of the asteroid belt (about 3.53×10^{21} kg),²¹ assume an average distance of 3 AU. Fully 2.30×10^{30} J would be required.²² That would use up the GPE contained within 5.56×10^{17} m² of crust, or 965 times the available surface area.

From reflectivity data, the mass of known trans-Neptunian objects is estimated to be 10–20% of Earth's mass and they orbit about 30 AU from the sun.²³ It would require 5.65×10^{32} J to raise the entire system of TNOs, assuming a mass of only 0.1 Earth masses.²⁴ This is five orders of magnitude greater than the available energy. Clearly, TNOs cannot all be derived from the earth.

What percentage of projectiles were vectored appropriately?

Most asteroids, comets, and TNOs orbit to within a few degrees of the plane of the solar system. Even if a projectile launched from Earth could escape collision with the sun, not all projectiles would be vectored correctly to attain the observed inclination to the ecliptic. Given a rotating earth and a hypersonic fissure the length of the mid-ocean ridges, it is expected that material would be ejected in all directions in the HPT scenario.²⁵ Moreover, a number of the launched projectiles would be destroyed by collisions with the sun. As such, a large proportion of this material would be useless for forming comets, asteroids, or TNOs.

Factors sapping the available work from calculated GPE

As shown in table 1, Brown's estimate of the total GPE (1.1×10^{27} J) is highly similar to ours (2.38×10^{27} J), even though he derived it in an entirely different manner.²⁶

Table 1. Comparing energy budgets. The HPT data were taken from Brown's table 38 (p. 599) and converted to joules. Given the many unknowns and the degree of approximation inherent in these studies, it is surprising that Brown's estimates for the energy required to create each of these systems is not significantly different from ours. Note also that our calculation in the first row included the Halley-type comets only. Also, the approximation for TNOs was calculated presuming that all projectiles were converted to TNOs rather than colliding with the sun or taking trajectories unlike those of modern TNOs.

	Brown 2008	Current Study
Comets	3.0×10^{27}	1.93×10^{25}
Asteroids	1.6×10^{29}	2.29×10^{30}
TNOs	1.1×10^{31}	5.46×10^{32}

Throughout our calculations, however, we have assumed 100% energy conversion, yet much of the GPE would be lost as heat, not converted to kinetic energy, which would dissipate some of the GPE to useless energy. Furthermore, some of the subterranean water would not have been released to the surface through the fountains of the deep, thereby locking up a considerable fraction of the total GPE calculated here.

There are also many energy-sapping mechanisms that HPT must resolve. For example, the hydroplates are supposed to have 'fluttered' during the breakup and movement of the crust, which would only serve to dissipate more of the available energy. Any non-laminar phenomena (friction, turbulence, etc.) would reduce the efficacy of the total available energy supply.

Exotic energy sources not dependent on GPE

As can be seen from this study, GPE from the HPT Earth system clearly cannot account for the tremendous energy (exceeding 10^{34} J) required to produce comets, asteroids, and TNOs. However, there are exotic energy sources that could be considered in addition to GPE. For example, stored chemical energy in the form of hydrated crystals should have existed under those high temperatures and pressures. Much heat could be released from pressure induced phase transitions within the hydrated crystalline formations deep underground. However, it would take time for that heat to reach the rock–water interface, and any extra energy input that happened later in the Flood year (i.e. after Day 40) would be lost to dissipative forces. Also, if the hydration energy exists only because the mineral is under pressure, this too becomes part of the GPE; there would be no 'extra' energy available. As always, one cannot get more energy out of a system than what was originally put in. If any of these depends on the gravitational potential energy, they cannot be used as an additional source of energy.

Some may object to these results by claiming the pressurized water would be in a supercritical state that would expand several magnitudes in volume as it was released. However, this too is accounted for by the potential energy calculation. HPT adherents are not postulating that God created a massive, supercritical underground water body and then capped it with an uncrackable shell that could withstand pressures greater than supplied by the tremendous overburden of the rock cap. Indeed, such a material is unknown to science. In HPT, however, the supercritical phase is supposedly maintained by the massive amount of gravitational pressure. The initial state is one of unstable equilibrium. Thus, one cannot extract more energy from the system than that provided by gravity.

In fact, if there was a phase change from supercritical to subcritical, there would be a tremendous loss of energy due to entropy, which would remove even more available energy from the system.

There are a few extraterrestrial mechanisms, however, that are not linked to the HPT energy budget. For example, low energy pathways can connect surprisingly distant points in the solar system.²⁷ These are complex routes that use the many Lagrange points between the major solar system bodies. These routes take much longer and require the application of the proper force at the appropriate time and direction. However, once a particle is in the slot, they can move great distances without additional input. Though some material ejected from the earth might be expected to find one of these routes at random, this is not an efficient means of putting Earth material into a trans-Neptunian orbit because the probability of any one particle finding one of these routes is minimal—so minimal that modern space exploration may utilize them only through *careful design and planning*. To achieve this objective through chance would require the amount of starting material to be astronomical for even a minute amount to succeed in reaching such a pathway. These pathways are also ephemeral, constantly changing with the movement of the planets. It would be special pleading to assume this happened *en masse*.

A related mechanism is the slingshot effect. Theoretically, with enough particles flying about in random trajectories, some of those particles could be involved in collisions that would cause them, for example, to pass behind Venus, Mars, and eventually Jupiter, in a series of slingshot events that could bring them to a high stellar orbit. Probability argues against this occurring on a grand scale. To bring even 1 kg to a high orbit through random collisions would require removing a significant amount of the energy in the system, negating this as a workable solution.

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A third passive mechanism is solar wind, which constantly pushes smaller particles outward. Small particles are not gravitationally self-attractive, however, and they are usually negatively ionized by the solar wind, making them mutually repulsive. To form comets, asteroids, etc., from

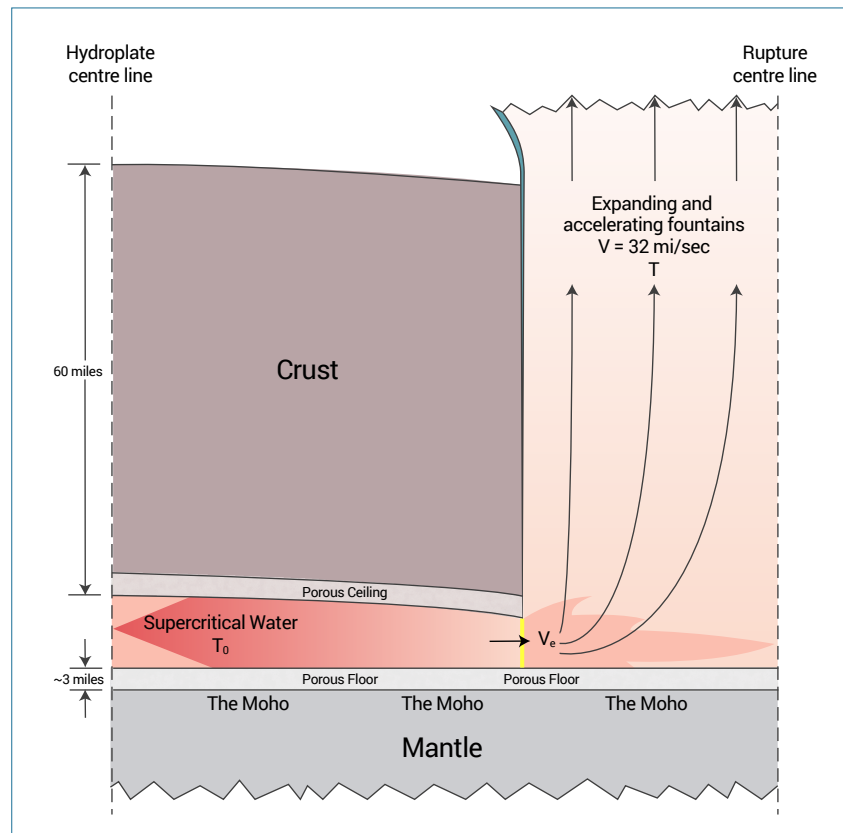


Figure 2. A stylized model of the HPT (not to scale, after Brown, figure 258, p. 583). The Moho marks the bottom of the porous, spongelike region, about 4.8 km (3 mi) below the chamber floor. The supercritical water acts like a rocket's propellant, escaping with a velocity v_e to the right of the rocket's nozzle (represented by the vertical yellow line).

the accretionary mechanics of microscopic particles, HPT runs into the same problems as the naturalistic nebular hypothesis for planetary formation: smaller bodies tend to obliterate one another whenever they make contact. Gravitational forces do not overcome this until after a body is greater than about 1 km in diameter. As such, solar wind impedes the formation of asteroids, comets, and TNOs rather than reinforcing it. The solar wind is also quite weak. Its nominal dynamic pressure ranges from 1×10^{-9} to 6×10^{-9} N/m² at 1 AU.²⁸ Thus, the solar wind would have little effect on the trajectory of a projectile moving greater than Earth's escape velocity. It also pushes outward in all directions, so the inclination of a projectile to the ecliptic would still largely be determined at its origin.

Other energy sources, such as heating from the rock below, heating from tidal pressure cycling before the Flood, and heating due to electrostatic forces in the columns holding up the 100-km-thick granite crust, also have the difficulty of efficiently transferring the energy to the subterranean water to be used effectively in asteroid formation. Moreover, these sources would supply

negligible amounts of energy compared to the other sources considered in this paper, and so fall short by several orders of magnitude. They are far too small to help HPT's case. Worse, there is a fixed limit to how much heat energy can be stored within the system. Once the outward pressure exceeds the pressure of the overburden, the shell cracks and the Flood ensues. GPE gives us a maximum value of the stored energy. Thus, our calculations are conservative.

Nuclear energy: an inadequate energy source

Brown propounds that the vast majority of energy required for the formation of comets, asteroids, and TNOs was provided by a tremendous input of nuclear energy from accelerated radioactive decay during the Flood year. This would have begun with the 'fluttering' of the upper crust causing massive piezoelectric discharges that, in turn, caused the breakdown of radioactive isotopes, which would have produced massive amounts of heat that would have been absorbed by the supercritical water. As Brown conveys:

"As the flood began, stresses in the massive fluttering crust generated huge piezoelectric voltages. For weeks, powerful electrical surges within Earth's crust—much like bolts of lightning—produced equally powerful magnetic forces that squeezed (according to Faraday's Law) atomic nuclei together into highly unstable, superheavy elements that quickly fissioned and decayed into subatomic particles and various isotopes, some of which were radioactive."²⁹

Brown estimates the heat energy contribution of deuterium alone to be 7.72×10^{30} J, which he uses as a 'conservative' figure for overall contribution to the fountains of the great deep during the formation of comets, asteroids, and TNOs:

"This is a conservative estimate of the nuclear energy added to the subterranean water, because other products of nuclear fission and decay would have added additional energy [contributing energy to the system], and some water was expelled permanently from Earth [removing energy from the system]. Energy was also required to form radioisotopes and, in effect, 'lift' them high above the floor of the valley of stability [removing energy from the system]; energy was also absorbed in forming some elements heavier than iron [removing energy from the system]."³⁰

Even if Brown's figure for nuclear energy contribution to the fountains is accepted, this still contributes too little energy, as it supplies a mere fraction of the energy required to form TNOs alone.

Though the contribution from other radionuclides could be invoked to explain the discrepancy of several orders of magnitude, little of this additional energy would be available to contribute to fuelling the fountains of the great deep. The massive piezoelectric discharges driving the process would have continued *throughout* the first 150 days of the Flood, while the fountains were actively ejecting crustal fragments for only the first 40 days. As such, a significant proportion of the nuclear energy could not be used by the fountains as it would be produced too late to be used in asteroid formation. Conversely, Hydroplate Theory's Compression Event (described in the Introduction) on day 150 is propounded to have catalyzed a massive meltdown event triggering accelerated nuclear decay:

"At the beginning of the flood, piezoelectric surges Z-pinched (fused) various stable nuclei along the surge paths into unstable proton-heavy and superheavy nuclei, some of which rapidly fissioned and decayed. Months later, the compression event (which ... lasted less than 1 hour) suddenly generated even more powerful piezoelectric surges which caused accelerated radioactive decay."³¹

With a surge of accelerated radioactive decay occurring during the so-called Compression Event, much of the 'additional' nuclear energy would have been produced long after the fountains had ceased ejecting crustal fragments. As such, nuclear energy cannot be treated as some 'infinite' source of energy for the formation of comets, asteroids, and TNOs. Instead, nuclear energy remains a finite source still too minute to explain their formation.

Conclusions

Through the application of elementary Newtonian physics, we demonstrated that the energy required to propel even a single comet from the earth to the orbital distance attained by Halley's Comet would require a considerable amount of the total available energy. This does not include the massive energy losses expected from converting the gravitational potential energy of the original system to the kinetic energy of ejection. If any significant number of comets or asteroids were created in this way, there would be little energy left for any other work, like moving continents and raising mountains. Yet, for *any* comets, asteroids, or TNOs to have survived to today, many thousands of times more mass must have been launched from Earth in various directions and velocities. A large proportion would have been swept out of the solar system after impacting with the sun or planets, yet the energy to create them is simply not there. This claim by the HPT model is formally invalidated.

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2. “About half the water now in the oceans was once in interconnected chambers, 60 miles below the entire earth’s surface.” Brown, ref. 1, p. 124.
3. In Brown, ref. 1, p. 596, he says, “for simplicity, we will say that it was at least 1 mile thick. It could have been much thicker when one considers (1) how much pre-flood subterranean salt water could still be trapped far below the Earth’s surface, and (2) how much subterranean water was launched into space.” We are using his figure of 1 mi, acknowledging that much of the gravitational potential energy would still be locked up beneath the crust today and that an unknown amount would be unaccounted for in the ‘launched’ water.
4. Brown, ref. 1, p. 597.
5. Sharing many characteristics with asteroids, TNOs are minor planets found beyond the orbit of Neptune.
6. Brown, ref. 1, pp. 125 and 128.
7. Brown, ref. 1, p. 339.
8. Once the rift was wide enough and the floodwaters were deep enough, the fountains were ‘shut off’ and the supersonic jet would transition into a diffuse horizontal water flow as the water continued to pour out from beneath the granitic crust. See Brown, ref. 1, p. 493.
9. Oard, M., Analysis of Walt Brown’s Flood model, creation.com/hydroplate-theory, 7 Apr 2013. Note that the crust was less in this version of Brown’s model.
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13. In Brown, ref. 1, p. 162, this is listed under HPT Prediction 8: “The mean radius of the Earth has shrunk about 180 miles since before the flood. Earth is still shrinking, but at a much slower rate.”
14. Alternatively, the volume of a thin spherical shell is approximately $4\pi r^2 t$, where t is the thickness of the shell. In this case, the upper crust has a volume of $5.69 \times 10^{10} \text{ km}^3$. We will use the value given in the main text and include this only for the sake of completeness.
15. Mass of HPT outer crust: $5.67 \times 10^{10} \text{ km}^3 \times 2.67 \text{ g/cm}^3 \times 1 \times 10^{15} \text{ cm}^3/\text{km}^3 \times 1 \times 10^{-3} \text{ kg/g} = 1.52 \times 10^{23} \text{ kg}$.
16. GPE of the HPT crust: $1.52 \times 10^{23} \text{ kg} \times 9.81 \text{ m/s}^2 \times 1,600 \text{ m} = 2.38 \times 10^{27} \text{ joules (J)}$. In his energy calculations, Brown uses ergs, a non-SI unit. One erg = $1 \times 10^{-7} \text{ J}$.
17. GPE per square metre: $2.38 \times 10^{27} \text{ J} / 5.76 \times 10^{14} \text{ m}^2 = 4.13 \times 10^{12} \text{ J/m}^2$.
18. Energy required to reach escape velocity of Earth: $6.67 \times 10^{-11} \text{ m}^3/\text{kg/s}^2 \times 1 \text{ kg} \times 5.97 \times 10^{24} \text{ kg} / 6.77 \times 10^6 \text{ m} = 5.88 \times 10^7 \text{ J/kg}$.
19. Energy required to reach escape velocity of sun from 1 AU: $6.67 \times 10^{-11} \text{ m}^3/\text{kg/s}^2 \times 1 \text{ kg} \times 1.99 \times 10^{30} \text{ kg} / 1.50 \times 10^{11} \text{ m} = 8.87 \times 10^8 \text{ J/kg}$. Energy required to reach escape velocity of sun from 18.3 AU: $6.67 \times 10^{-11} \text{ m}^3/\text{kg/s}^2 \times 1 \text{ kg} \times 1.99 \times 10^{30} \text{ kg} / 2.74 \times 10^{12} \text{ m} = 4.85 \times 10^7 \text{ J/kg}$. Energy required to lift 1 kg from 1 to 18.3 AU in the sun’s gravity well: $8.87 \times 10^8 - 4.85 \times 10^7 = 8.38 \times 10^8 \text{ J/kg}$.
20. Energy is calculated for the average orbital distance, rather than perihelion, because an elliptical orbit would require the same energy as the circular orbit that is its average distance.
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22. Energy required to reach escape velocity of sun from 3 AU: $6.67 \times 10^{-11} \text{ m}^3/\text{kg/s}^2 \times 1 \text{ kg} \times 1.99 \times 10^{30} \text{ kg} / 4.49 \times 10^{11} \text{ m} = 2.96 \times 10^8 \text{ J/kg}$. Energy required to lift 1 kg from 1 to 3 AU in the sun’s gravity well: $8.87 \times 10^8 - 2.96 \times 10^8 = 6.50 \times 10^8 \text{ J/kg}$. Multiplying by $3.53 \times 10^{21} \text{ kg}$ gives us the amount of energy required to raise the asteroid belt from the surface of the earth = $2.30 \times 10^{30} \text{ J}$.
23. Shulz, R., Trans-neptunian objects, *The Astronomy and Astrophysics Review* 11:1–31, 2002.
24. To three significant figures, the energy required to reach escape velocity of sun from 1 AU is identical to the energy required to lift a mass from 1 to 30 AU, so the energy required to lift the TNOs = $8.87 \times 10^8 \text{ J/kg} \times 5.97 \times 10^{23} \text{ kg} = 5.65 \times 10^{32} \text{ J}$.
25. Presuming that projectile launch sites were randomly distributed across Earth’s surface is a simplifying assumption. This is not entirely true, as mid-ocean ridges are not randomly distributed across Earth’s surface. After accounting for Brown’s postulated Earth roll, over 10% projectiles would be launched from a region near the south pole. This would vector many of the projectiles at near-normal pathways to the ecliptic, unlike present-day observation.
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30. Brown, ref. 1, p. 429.
31. Brown, ref. 1, p. 400.

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With over a decade of study to his credit, **Edward Isaacs** is a keen student of the sciences, focusing on the geological processes of the Genesis Flood and ensuing Ice Age. As a creation researcher and educator, Edward is an ambassador of Logos Research Associates.

The origin of large arcs: part 1—currently proposed mechanisms for large arcs

Michael J. Oard

Large arcuate features (>30 km diameter), especially mountain ranges and island arcs, are common and mysterious to uniformitarian scientists. They are often associated with outward-verging thrusts from a central basin, like those in the Mediterranean and southern Europe. Various mechanisms have been proposed to explain large arcs. Computer and box models are used to show the development of an orocline—a curved orogenic belt. However, computer and box models are inherently inaccurate due to unknown variables and the effects of scale. Buckling parallel to a high viscosity ‘orogen’ does not even work in box models. Buckling of an orogen by a perpendicular force is a reasonable mechanism, since the centre can move farther, while the flanks are retarded by friction. Subduction zone rollback is commonly advocated, but the horizontal slab-pull force is much weaker than mantle resistance. Gravity spreading can form large arcs, such as the Jura Mountains of central Europe. The leading edge of submarine slides can be arcuate.

Geomorphologists study landforms on the surface of the Earth. Some of these landforms, especially mountain belts, have an arc shape in map view, and sometimes these arcs appear to have once been circular.¹

Large arcs are more common than most geologists realize. Calignano *et al.* state: “Curved orogenic [mountain] belts are rather common structures in contractional settings, and their origin is attributed to various mechanisms.”²

Examples of large arcs

The Himalayas are an arc-shaped mountain range (figure 1). South and west of the Tibetan Plateau, they form an arc, which, if part of a circle, would have a radius of 1,696 km.³ Oroclines also include sections of coastlines, such as the Bolivian Andes⁴ (figure 2) and the Gulf of Mexico, with a radius of 750 km (figure 3).

Many arcuate mountain ranges with radii between 100 and 300 km are found in southern Europe and the Mediterranean (figure 4).⁵ All of these large arc structures are outward-directed thrusts from a subsided basin filled with thousands of metres of sediments within the concave side of the arc. The Betic and Rif Mountains of the western Mediterranean, called the Gibraltar Arc, form a tight semicircle with a radius of about 100 km, in which thrusts have moved outward from the sunken Alboran Basin.^{6,7} The Rock of Gibraltar, an uplifted limestone block, is part of this arc (figure 5).

The bottom of the Alboran Sea, between Spain and Africa is deformed and metamorphosed. The West Alboran Basin is a deep sub-basin that contains sediments greater than 10,000 m thick.^{8,9} The bottom layers of sediment appear partially chaotic and tilted with debris flows.⁸ The majority of the

sediment above the bottom layers is mostly undeformed, as if the basin opened up and deepened quickly and was rapidly filled in with little subsequent deformation. Farther east, the small East Alboran and South Alboran Basins contain only a few thousand metres and 4,000 m of sediment, respectively.¹⁰ There is also a narrow North Alboran Basin with several thousand metres of sediments. The central part of the Alboran Sea between the basins consists of uplifted, metamorphic rocks that are similar to the internal zone of the surrounding mountains.⁸ Volcanism has occurred mainly within the eastern part of the basin and the surrounding mountains.¹¹

The western Alps are tightly curved with outward-directed thrusts from the Po Basin to the east, containing thick sedimentary rocks, while the northern Apennine Mountains of Italy are more gently curved (figure 6). The Calabrian arc extends from the southern Apennine Mountains through Calabria to Sicily (figure 7). The northern and central Apennines are thrusts with an eastward vergence toward the Adriatic Sea from the vicinity of the extended Tyrrhenian Sea (figure 7). The direction of vergence is the upward direction of the thrust or the direction of thrust movement. The seemingly straight Appalachian Mountains include arcuate sections.

Island arcs in the ocean, especially the western Pacific Ocean, are conspicuous, e.g. the Ryukyu Island arc (figure 8). It is an arc-shaped mountainous belt that lies mostly underwater. The mountains are typically volcanic. Some island arcs form parts of nearly perfect circles,¹² such as the eastern Banda Island arc. They have a deep-sea trench parallel to the volcanic arc on the convex side. A ‘volcanic arc’ can also include the features adjacent to the volcanism, such as the trench, the forearc between the trench and the

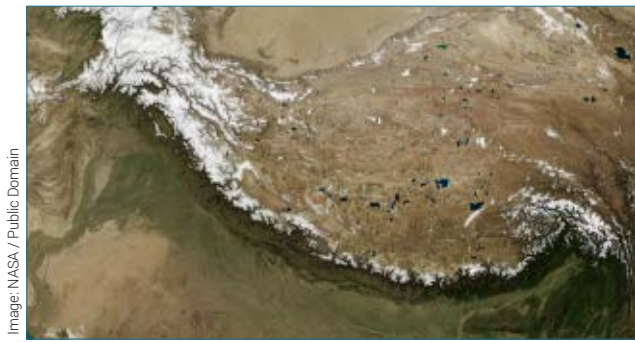


Figure 1. Arc-shaped curvature of the Himalaya Mountains shown by the snow cover

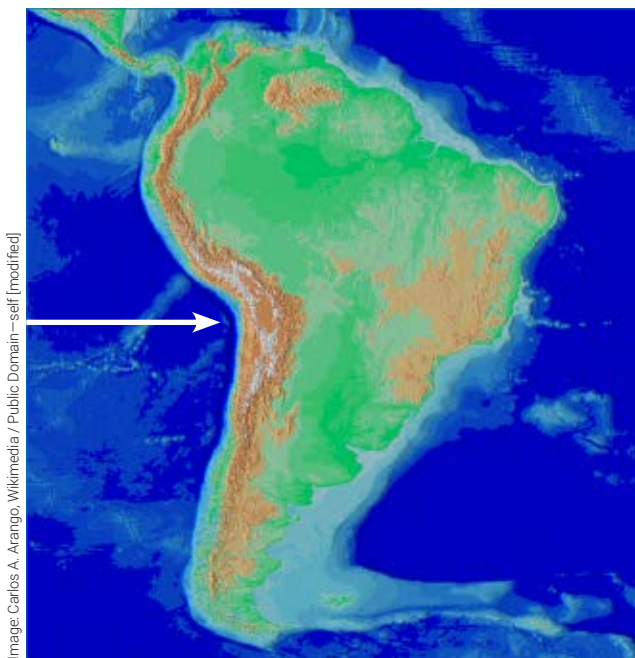


Figure 2. The Andes Mountains of South America showing the orocline off the coast and the Andes Mountains (arrow)



Figure 3. Shoreline of the Gulf of Mexico

volcanism, and the back-arc basin to the rear of the volcanism within the concave portion of the volcanoes.

Large arcs are uniformitarian mysteries

Many large arc-shaped structures are mysterious to uniformitarian scientists, often subject to multiple, extremely tentative suggestions for their origin. For instance, many large arcs show outward thrusting from the interior with the centre sometimes presenting a subsided, extensional basin often filled with sediments, for instance the Mediterranean arcs described above. Such outward vergence of arc thrusts is common in the Mediterranean area, and such arcs are a significant tectonic puzzle for uniformitarian geologists:

“A puzzling characteristic of the western Alpine system is the tight curvature of a number of segments of the orogenic belt, such as the Carpathians, the Hellenides, the Apennines-Maghrebides, the Betic-Rif-Tell system. ... On the concave side of these arcuate mountain belts, areas of recent (Miocene to present) subsidence are found, such as the Pannonian, Aegean, Tyrrhenian and Alboran basins.”¹³

Most large arc-shaped structures are considered *oroclines*, which are formally defined as a mountain belt with an imposed curvature or sharp bend believed to have formed by rotation of fold and fault traces around a vertical axis.¹⁴ However, numerous investigators have noted that large arc-shaped structures, both those typically labelled ‘oroclines’ and others, are difficult to explain in uniformitarian terms. Smith *et al.* state: “Curved orogenic belts, commonly referred to as oroclines, are ubiquitous geological features. However, the origin of oroclines is a matter of debate.”¹⁵ Others concur:

“Orogenic curvature is a ubiquitous feature of mountain belts, and the plate tectonic and geodynamic setting responsible for the development of curved orogens is a subject of debate.”¹⁶

Johnston *et al.* have written:

“Understanding how map-view curvature of geologic structures, ranging from individual thrust sheets all the way to entire mountain belts ... form and evolve is a first-order Earth system problem.”¹⁷

Lamb and Mortimer repeat that large arcs are ubiquitous and enigmatic:

“Curvilinear mountain belts and metamorphic terranes are ubiquitous in the continents, but their origins commonly remain largely enigmatic, with multiple hypotheses for their mechanisms of formation.”¹⁸

Since large-scale arcs are not forming today, they violate the uniformitarian principle and are subject to much speculation:

“However, contrary to previous suggestions that assume that the whole lithosphere can buckle, there

is no clear evidence that such processes occur in modern tectonic environments. ... The reconstruction of ancient oroclines remains a problematic issue. If ancient oroclines formed in a similar way to modern analogues, then it is likely that the geodynamic processes associated with their formation occurred at scales and durations that are too difficult to detect by the resolution of available geological data.”¹⁹

Proposed mechanisms for large arcs

In light of this mystery, it should be no surprise that secular scientists have proposed many mechanisms for the formation of large arcs (table 1). The list in table 1 is not exhaustive.^{20–23} None are observed forming today, so the proposals are very difficult to test. Computer and box models are often developed to test the viability of these mechanisms. However, researchers commonly ignore, or don’t comprehend, an alternative mechanism for forming large arcs—impacts of asteroids or comets. The arcuate shape of impacts is seen throughout the solar system, and it motivated Stewart to try to differentiate buried impact structures from others that have resulted from more mundane geological causes.²⁴ Now, impacts will not explain *all* large arc-shaped structures, but the fact it is largely ignored as an explanation needs to be re-examined. While current proposed mechanisms for their formation may suffice in some instances, they fall short in others, especially where an impact origin may be most viable. Part 1 will explore the prospects of the most common explanations offered for large arc-shaped structures. Part 2 will focus on the overlooked impact thesis and explore its prospects and challenges.

Models are limited and/or inaccurate

It is important to understand the pitfalls of using box or computer models, since interpretations of earth science models depend on the output of these models. Too many researchers take the results of their models too seriously. The problem with using models is that they are, at best, simplifications of nature. As one who has worked with numerical models,²⁵ I have seen firsthand how the choice of initial and boundary conditions can greatly influence the result. The physics of each variable must be worked out, and its linear and nonlinear interactions with other variables known. This is true for weather and climate models, and it is true for models of Earth’s crust and mantle.

Sensitivity tests are commonly helpful and allow weighting of variables and their interactions. For example, dozens of climate models have tested the global temperature increase with a doubling of carbon dioxide in the atmosphere. This tests the *sensitivity* of an increase in carbon dioxide.



Image: O'H 237, Wikimedia CC-BY-SA-4.0

Figure 4. The Mediterranean Sea area and southern Europe showing six arcs thrust outward, with four having a deep subsided basin on the concave side of the arc



Image: Gbnews.net, Wikimedia Public Domain—self

Figure 5. West face of the Rock of Gibraltar



Image: Perconte, Wikimedia / CC-BY-SA-2.5

Figure 6. The Alps, colour-coded by altitude, showing the tight curvature of the western Alps

Table 1. Possible mechanisms to explain large arcs. These mechanisms can occur alone or in combinations. This list is not exhaustive.

Currently proposed mechanisms from the secular literature

1. Vertical axis rotation
2. Buckling by a force parallel to an orogen
3. Buckling by a force perpendicular to an orogen
4. Subduction rollback
5. Deformation of fold and thrust belts
6. Gravity spreading and thrusting
7. Submarine slides



Figure 7. Apennine Mountains of Italy with the Calabrian Arc from the southern Apennines through Calabria to Sicily. Light dashed line southeast of the Calabrian Arc is the external Calabrian Arc.

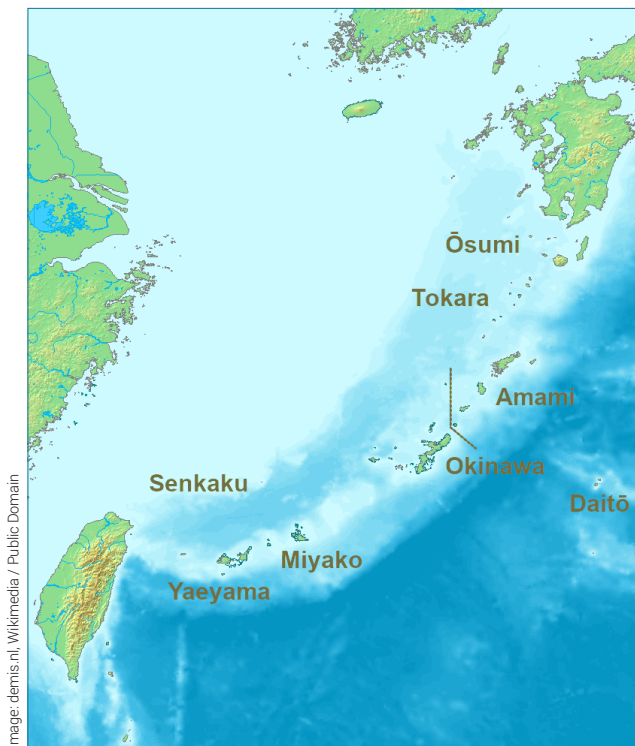


Figure 8. Ryukyu Island arc between Taiwan and Japan

Temperature warms from about 1.5–6°C. The wide range indicates significant variability within the models. But the official temperature rise after the period 1850 to 1900 has been only about 1°C.²⁶ Some of this rise is due to warm climate biases (i.e. urban heat island effect for cities of about 100,000 population) still existing in the long-term temperature data.²⁷ Moreover, based on correlations in the 20th century, it is likely that natural processes, such as effects on the sun, variable volcanism, and cyclical ocean current changes, can account for around 50% of the global warming. So man's contribution to global warming, by adding carbon dioxide and other greenhouse gasses to the atmosphere, is likely around 0.5°C.

Observations can tell us even more. Carbon dioxide, as of 2016, has increased 50% since the industrial revolution.²⁸ Also, other greenhouse gases, such as methane and nitrous oxide have increased the greenhouse gas effect 34% more, for a total of 84%; almost a doubling of greenhouse gases. This result is about six years old, and both the temperature and greenhouse gases have risen since then. The 'official' global average increase in temperature rise since 1850–1900, as of 2021, is about 1.0°C, while greenhouse gases have nearly doubled. So, if natural processes account for half the global warming, this means that man doubling greenhouse gases has resulted in a temperature rise of only 0.5°C. Therefore, the climate simulations are much *too sensitive* to the effects of increased greenhouse gases. Even the lowest predicted increase of 1.5°C is about three times too high. These kinds of problems need to be evaluated in models of crustal features.

Vertical axis rotation

Most of the mechanisms for forming large arcs apply to oroclines, although oroclines are a subset of large arcs. Oroclines are believed to have formed by rotation on a vertical axis.²⁹ Vertical axis rotation is often claimed in analyzing various areas. Such rotations are difficult to prove, and there should be major extensional features along the strike of arcs, but these are not always found.³⁰ It seems like it would be mechanically difficult to rotate rock, especially if the whole crust or even the whole lithosphere was involved in the rotation.

The formation of oroclines by vertical axis rotation or by bending of a force perpendicular to the long axis of the orogen or buckling by forces parallel to the orogen are claimed to be supported by geological, structural, and paleomagnetic data.³¹ Paleomagnetism is really the key piece of evidence they use to indicate rotated rocks.³² But these paleomagnetic and structural features can be difficult to analyze and interpret:

“Unravelling the kinematics and deformational mechanisms of areas that underwent several tectonic

events is a complex task that has to be solved backwards in time, especially when dealing with vertical axis rotations (Pueyo *et al.*, 2016): It is impossible to solve accurately the oldest movements without solving the youngest ones.”³³

In Spain, the researchers at one time claimed that there was a clockwise rotation of greater than 20° in the Cenozoic and a counter-clockwise rotation of about 70° in the Carboniferous. In a later paper, they apparently have given up on the rotations.³⁴ In regard to paleomagnetic interpretations, they state that researchers must be careful of paleomagnetic deductions:

“Despite its uniqueness to study paleolatitudes and vertical axis rotations, paleomagnetism is not flawless. Paleomagnetic data can yield spurious rotations when the local and regional structures are not properly defined and their geometries and kinematic histories are not adequately corrected for (e.g. Pueyo *et al.*, 2016). In addition, the age of magnetization acquisition is not necessarily equivalent to the age of the sample rocks. Remagnetizations are ubiquitous, especially in orogens.”³⁵

In another study of an orocline on Tasmania, the authors admit that the primary magnetism, after supposedly excluding later paleomagnetic overprinting, is weak.³² The later overprinting is pervasive. Two of these paleomagnetic events were even considered ‘stable’.

Buckling by a force parallel to an orogen

One possible mechanism for forming large arcs in a box model is that of applying a force parallel to a linear ribbon of higher viscosity, representing a mountain belt. Layers of rock can be included that could represent the upper crust, lower crust, or upper mantle lithosphere. When the sides of the box are pushed inward, parallel to the direction of the ribbon, the ribbon deforms.^{20,36} Ideally, the lateral push would produce an arc (figure 9).

Smith *et al.* tested the buckling of a linear ribbon with a parallel force in a box model.³⁷ Regardless of varying the viscosity within the ribbon, using different layers of material, and other variables, their box models failed to product arcs.

Buckling by a force perpendicular to an orogen

Another possible mechanism for large arcs is a force perpendicular to a linear mountain belt, as shown in the simple box model in figure 10. This mechanism has merit. Calignana *et al.* showed, in a box model, that arcs can sometimes form when one wall is moved perpendicular to a ribbon of higher viscosity representing a mountain belt.³⁸

Arcs do form, mainly by thrusting. It is likely wall friction helps form arcs, which would still mimic the edges of a thrust that are held back by friction. But there are other more chaotic features, such as backthrusts with areas not curved. This mechanism can more easily be explained by the 6th mechanism in Table 1, thrusting.

Subduction rollback

Subduction rollback, also called slab or trench retreat, is the fourth possible mechanism for the formation of large arcs. This is the most common explanation for island arcs and is sometimes combined with thrusting. Supposedly, only old heavy oceanic lithosphere is believed to be able to roll back,³⁹ although it is sometimes claimed that the ‘young, warm’ Cascadia subduction zone is rolling back.⁴⁰ During rollback, the subduction zone is believed to move in the direction of thrust vergence (figure 11). The force that moves the subduction system is the horizontal slab pull force (figure 11). The mantle rock that is being pushed away is believed to flow horizontally around the edge of the slab and into the mantle wedge in toroidal flow.⁴¹ Applying an admittedly simple lab model, Schellart states how an island arc forms by trench rollback:

“The results show that the radius of trench curvature (R_{TC}) progressively decreases with continuous trench retreat due to quasi-toroidal mantle return flow from the subslab region around the lateral slab edges and toward the mantle wedge region.”

The arc probably forms by a drag force from the edges of the subduction zone.

The vertical component is the force that drives the subducting slab downward, which brings up the problem of what force causes ‘flat subduction’? These flat slabs can be several hundred kilometres under the upper plate⁴² and sometimes about 100 km deep, well into the upper mantle.⁴³ Van Hunen *et al.* recognize this problem: “However, the presence of shallow horizontal subduction does not fit into such a model [of a gravitational force caused by slab pull]”.⁴⁴ Ten percent of the subduction zones have flat to nearly flat subduction.⁴⁵ Despite many models, flat slab subduction remains a mystery of plate tectonics.⁴² It is possible that catastrophic plate tectonics can solve the problem of flat subduction, especially by the suggestion that the upper plate moves up and over the Wadati-Benioff zone, such as occurs with the North and South American plates.

Rollback is a difficult geophysical mechanism.⁴⁶ The major problem with subduction rollback is that the horizontal slab pull force is much too weak compared to the force needed to move the upper mantle away from the subduction zone:

“However, in order to allow the slab to move back, the slab retreat needs that also the mantle of the

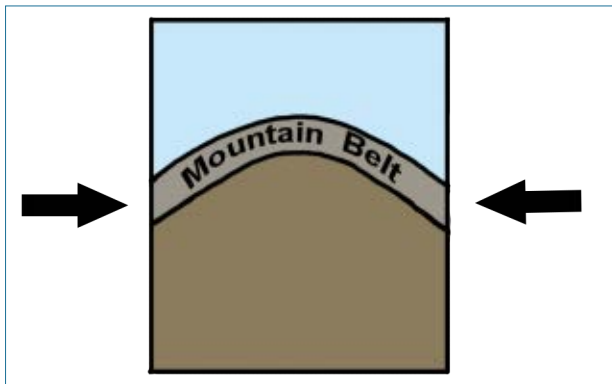


Figure 9. A simple box model in which a linear band of higher viscosity is pushed from the sides, parallel to the band, ideally producing an arc (drawn by Melanie Richard)

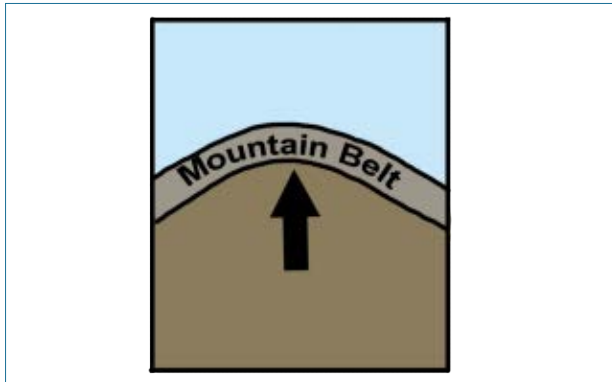


Figure 10. A simple box model in which a linear band of higher viscosity is pushed perpendicular to the band in the centre, ideally producing an arc (drawn by Melanie Richard)

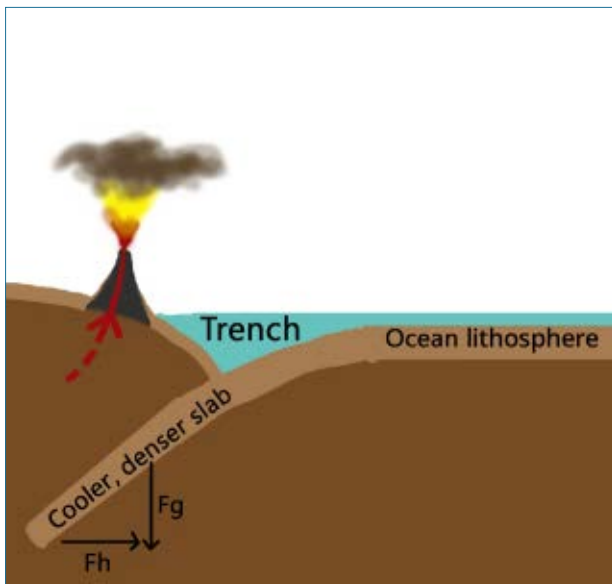


Figure 11. Horizontal and vertical components of the slab pull force. It is F_h that is supposed to cause slab rollback (drawn by Melanie Richard).

footwall [descending plate] of the slab moves away in the direction of the slab retreat. ... However the slab pull has not the energy to push back eastward [for western Pacific subduction zones] the whole section of mantle located east of the slab in order to allow the slab rollback.⁴⁷

For deep slabs down to 660 km, the whole upper mantle and transition zone must be pushed in the direction of slab rollback. For the western Pacific subduction zones, this is toward the east. For toroidal flow, the viscosity of the mantle would have to be unusually low, at least in standard plate tectonic models, and the horizontal mantle flow may have to flow over 1,000 km to find a subduction zone ‘edge’, especially for arcuate slabs.

Deformation of fold and thrust belts can sometimes form arcs

Of the seven suggested mechanisms, the third to the last one, deformation of fold and thrust belts, matches field data most completely. It is observed in some mountain ranges of Wyoming and in the Mediterranean Sea region. The frontal edges of upthrust mountain ranges are sometimes arcuate, such as the Wind River Mountains of west-central Wyoming that were overthrust west to southwest up a 30° angle forming a general arc shape.^{48,49} The slantwise uplift is 14 km vertically and 26 km horizontally toward the southwest compared to the upper crust in the Green River Basin. Arcs from thrusts likely formed by rapid motion in which the centre moved farther out while the edges were hindered.

Gravity spreading and thrusting sometimes form large arcs

Gravity spreading, the vertical collapse and lateral spreading of any overburden under its own weight,⁵⁰ is another suggested mechanism for the formation of large arcs.²² It is essentially like a giant slump (figure 12).⁵¹ Listric normal faults are typical of the vertical collapse with several thrusts ejected laterally over a décollement (figure 13). Gravity spreading is distinguished from gravity sliding, which is simply the downslope movement of a rock mass on a slope due to gravity. Gravity sliding would include debris flows and turbidity currents.

Jura Mountains

Sometimes gravity spreading and thrusts combine to form an arc shape at the leading edge, likely caused by the centre moving farther than the edges that are held back by the force of friction, e.g. the Jura Mountains in southern Europe (figure 14). This mountain belt likely was formed by rapid gravity spreading, with the potential energy for thrusting

in the Jura Mountains coming from the northwest side of the rising Alps, where stacks of nappes (thrusts) occur.⁵² Southeast of the frontal thrust, Smeraglia *et al.* showed a vertical uplift called the Préalpes.⁵³ As the northwest edge of the Alps sank gravitationally, the leading edge of the spreading would move northwest about 100 km in the centre and ending up with a radius of curvature of 200 km.⁵⁴

The southwest–northeast Molasse Valley is the likely filled trough or ‘slump valley’ left behind during normal faulting and thrust faulting. This valley contains up to 4,000 m of generally horizontal sedimentary rocks that thicken southeast.⁵⁵ The northwest verging folds and thrusts of the Jura Mountains moved northwest on a décollement (figure 13). When the mass stopped, a series of stacked thrust sheets occurred,^{55,56} such as also occurred east of the uplifting Rocky Mountains in central Montana during the Flood.⁵⁷ Gravity spreading is likely how many thrust systems formed.^{57–59} Arcs from slides and thrusts are likely formed because the fastest area of sliding is usually in the centre, with friction at the edges slowing the mass down.

Passive margins

It seems that gravity spreading can sometimes form large arcs, but many times it does not, as observed from seismic profiles along the margins of continents and large islands. Continental margins which are not affiliated with a subduction zone are classified as passive margins. An example of a passive margin is the continental margin off the eastern US. Active margins are associated with subduction zones in plate tectonics, such as off the west coast of South America.

Gravity spreading features are common around passive margins, such as at the edge of the Niger Delta (figure 15)⁶⁰ and off the Orange Basin, offshore Namibia:

“A regional seismic line through the Orange Basin, offshore Namibia, reveals a classic paired, gravity-driven high on the submarine slope and contraction toward the toe of slope.”⁶¹

The reason such gravity spreading did not form large arcs is likely because the slumping occurred along the long length of the continental margin and there were no pinning points from which a large arc could form.

The Hilina slump

Slow gravity spreading has been observed at the south coast of the island of Hawaii due to upward magma movement in the Kilauea Volcano. This feature is called the Hilina slump (figure 16) and shows listric extensional normal faulting south of the Kilauea Volcano, providing the gravitational potential energy for imbricate overthrusts from a décollement (figure 13).^{62,63} Earthquakes on the décollement indicate that it occurs as deep as 7 km below sea level with

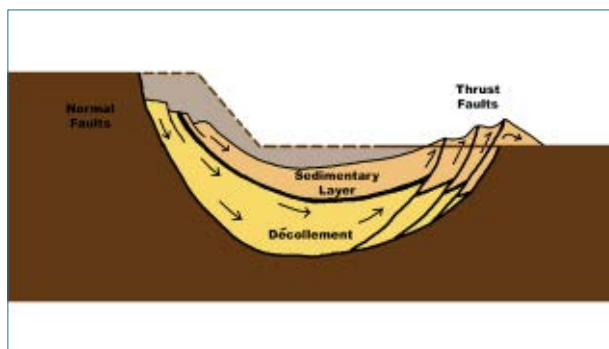


Figure 12. A rotational landslide slump with normal faults at the upper end and thrust faults splaying out from a décollement. Notice the trough in between the normal and thrust faults (redrawn from Melosh,⁵² p. 339 by Melanie Richard).

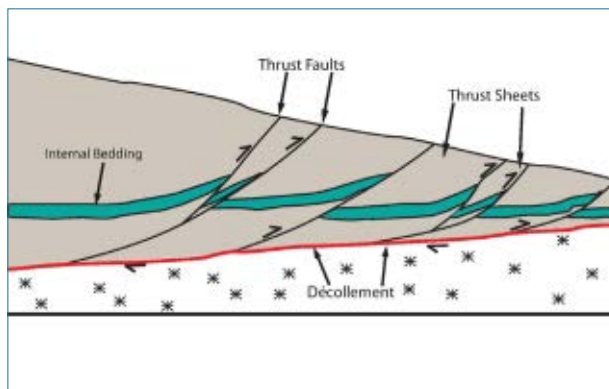


Figure 13. A basal décollement on undeformed rock with imbricate thrust above. Thrusts caused by compression toward the right side of diagram.



Figure 14. Satellite view of the arcuate Jura Mountains with the flat, sediment-filled Molasse basin to the southeast

Image: Théri3, Wikimedia / CC-BY-SA-3.0

Image: Jacques Descloitres, MODIS Rapid Response Team, NASA/GSFC/
Public Domain

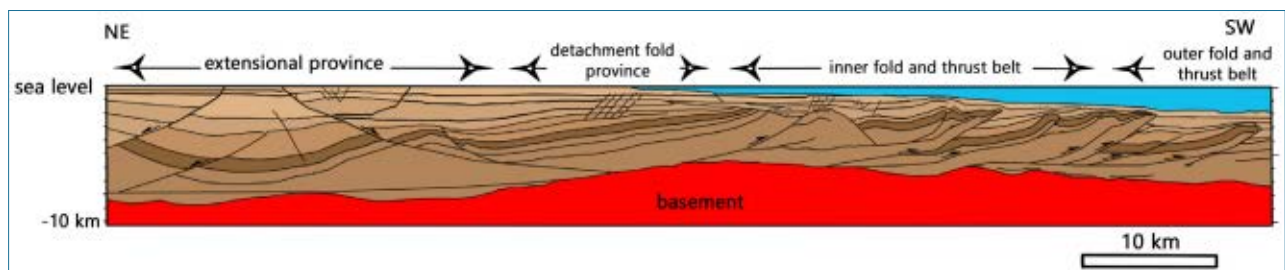


Figure 15. Cross-section through the continental margin off the Niger Delta (from Bilotti and Shaw, 2005, *AAPG Bulletin*). Notice that the cross-section goes from extensional, normal faults just offshore (left) to multiple stacked thrusts oceanward (toward the right).

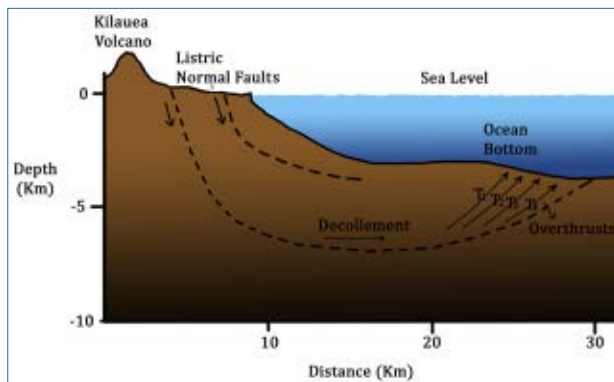


Figure 16. Hilina slump on the south flank of the Kilauea Volcano, Hawaii (drawn by Melanie Richard from the literature^{65–67,76})

another possible shallower detachment fault.^{64,65} Because of the Loihi Volcano holding back the slump on the west side, a rough arc shape occurs on the western flank of the slump.⁶⁶

Gravity spreading also occurs along some active margins

Some active margins also exhibit gravity spreading as with the Peru-Chile and Middle America active margins.⁶⁷ Extensional normal faults occur on the upper continental shelf with overthrusting on the lower continental slope. Such extensional features are especially anomalous in forearcs that are supposedly backstops for the off-scraping of converging oceanic sediments. Bourgois *et al.* state, in reference to the Peru-Chili forearc:

“The Andean margin off Peru is an ‘extensional active margin’ or a ‘collapsing active margin’ developing a subordinated accretionary complex induced by massive collapse of the middle slope area.”⁶⁸

The discoveries of the giant slump-like profiles of the forearc were attributed to ‘subduction erosion’. This is a new *ad hoc* mechanism that supposedly occurs on half of the convergent margins.⁶⁹ In subduction erosion, the lower plate erodes the base of the upper plate below the forearc, which subsequently collapses vertically, forming extensional

features on the continental shelf and overthrusts on the continental slope.

Some submarine slides can also form arcs

Large arcs with more rapid movement in the centre can also occur from some submarine slides, such as along the continental slope of the Gulf of Cadiz. Westward thrusts resulted in a 10-km-thick stack of thrust sheets in the eastern gulf.^{70–72} Iribarren *et al.* believe this imbricate wedge was rapidly thrust west,⁷¹ which would be consistent with the idea that the thrusts were caused by an impact in the area of the Alboran Sea.^{73,74}

West of these thrusts is a wedge of sediment that thins down the continental slope.⁷⁵ It forms an arcuate or double arcuate shape. It appears to have been a large debris flow, likely during or soon after thrusting. Slides, the seventh mechanism, have not been taken seriously as a mechanism for the formation of large arcs, likely because their context is obvious while the focus for arc mechanisms is mainly on mountain ranges.

Conclusions

Large arcs are common, mostly as mountain chains. Island arcs are located mainly in the western Pacific. Large arcs sometimes show thrusting verging away from a subsided basin filled with sediments. Since large arcs are not forming today, they are not satisfactorily explained by uniformitarians.

Out of many proposed mechanisms for large arcs, it appears buckling of an orogen from a perpendicular force, fold and thrust belts, gravity spreading, and submarine slides have the best prospects to explain large arcs. These large arcs are mostly caused by the centre moving farther, while the sides are held back by friction.

One obvious mechanism for large arcs that is mostly ignored by geoscientists is the impact of meteorites or comets. Rims of impact craters, circles or arcs, are commonly found on all the solid bodies of the solar system. Part 2 will delve into large arcs formed by impacts.

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What's wrong with being wrong: part 4a—a more than cursory look into evolutionary ethics

Marc Kay

In part 1, I examined problems associated with using evolution, a materialist philosophy, to explain ethics, a non-material discipline. Subsequent discussion addressed the failure of group selection and kin selection to explain how morality arose. This part critiques reciprocal altruism. Whereas the former aetiological accounts involve members of the same 'tribe' or close relatives, reciprocal altruism extends to actors beyond these restrictions. A significant problem is cheating, taking but not giving, and making sure the other is not aware you are free-loading. Game theory was designed to demonstrate how this obstacle to genuine altruism could be fixed in a population.

"I learn to do service to another, without bearing him any real kindness: because I foresee, that he will return my service, in expectation of another of the same kind, and in order to maintain the same correspondence of good offices with me or others. And accordingly, after I have served him, and he is in possession of the advantage arising from my action, he is induced to perform his part, as foreseeing the consequences of his refusal."

(Hume, D., Of the passions; in: *A Treatise of Human Nature*, vol. 2, J.M. Dent & Sons, London, pp. 223–224, 1956 (1739).

Reciprocal altruism

Hamilton had argued altruistic acts could be explained since the actors involved shared a close genetic relationship, and natural selection would favourably work to perpetuate these genes. Robert Trivers (figure 1) criticized models like this because they were "designed to take the altruism out of altruism".¹ Yet despite this misgiving, Trivers extended Hamilton's idea by proposing that "under certain conditions natural selection favors these altruistic behaviours [directed toward distantly-related and non-related members] because in the long run they benefit the organism performing them."² From this sophistry grew the now mainstream idea of reciprocal altruism.

Trivers famously posed a thought experiment involving a risk-cost-benefit calculus centred upon a drowning man and his rescuer. It was based upon the following propositions:

1. If no one attempts rescue, the man will almost certainly drown.
2. A rescuer, on the other hand, will almost certainly never drown.

3. In the unlikely event that a rescuer does drown, the victim will also.

4. In the very much more probable event of the rescuer surviving, the drowning man will too.

Trivers argued that if this were a one-off event the drowning man would never be rescued as the risk would exceed any future return. On the assumption, however, that rescuers may be exposed to drowning, the pay-off is potentially enormous:

"If we assume that the entire population is sooner or later exposed to the same risk of drowning, the two individuals who risk their lives to save each other will be selected over those who face drowning on their own. Note that the benefits of reciprocity depend on the unequal cost/benefit ratio of the altruistic act, that is, the benefit of the altruistic act to the recipient is greater than the cost of the act to the performer, cost and benefit being defined here as the increase or decrease in chances of the relevant alleles propagating themselves in the population."³

Trivers' thought experiment is designed to reduce complex behaviour into more manageable elements. It's not that there is an immediate reciprocated act, but that in the long-term future, benefits may accrue to those who act 'altruistically' to those in need. It's to this end that Trivers' theory has almost universally been compared with the Good Samaritan parable, and approvingly regarded by Daniel Dennett as "the first step towards human promise-keeping".⁴

On the surface the altruist gains nothing, not in the short term at least. Nevertheless, the altruist takes out something like an insurance policy: he may be throwing his resources away, even risking his life, by saving another, but if he ever gets into a predicament another altruist, who has similarly been helped, may be nearby and go to his aid.

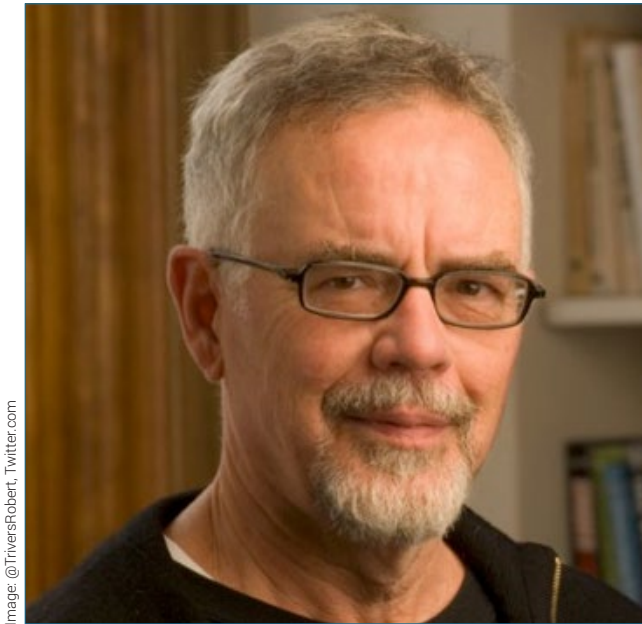


Image: @TriversRobert, Twitter.com

Figure 1. Robert Trivers is recognized as the conceptual founder of reciprocal altruism

$$\Sigma c_{ai} > \Sigma b_{aj}$$

Figure 2. Outright or gross cheating, as computed by Trivers' reciprocal altruism, can be formulated as $\Sigma c_{ai} > \Sigma b_{aj}$, "where c_{ai} is the cost of the i th altruistic act performed by the altruist and where b_{aj} is the benefit to the altruist of the j th altruistic act performed by the gross cheater" (Trivers, R.L., *The evolution of reciprocal altruism*, p. 223; in: Caplan, A.L., *The Sociobiology Debate*, Harper & Row, New York, 1978). The maths supposedly accurately describes and differentiates between the person who helps the old lady across the street and the person who helps himself to the old lady's handbag.

Cheats do prosper ... sometimes

Such explanations consistently raise the problem of 'cheating',⁵ where an individual 'parasites' off the altruists' good-will. The cheater believes that her gains will always outweigh any possible future recriminations for not reciprocating, these latter usually understood to be zero, hence the decision to cheat—contrary to the adage, cheaters *can* prosper. Given the reproductive advantage of cheating, why is the world not full of cheaters? The evolutionist raconteur has several explanations.

One is that cheats can only continue to do so until a critical mass of altruistic individuals is reached. The altruists will then withdraw their favours, creating an environment in which cheats no longer flourish. Trivers contends that:

"Selection will discriminate against the cheater if cheating has later adverse affects [*sic*] on his life which outweigh the benefit of not reciprocating. This

may happen if the altruist responds to the cheating by curtailing all future possible altruistic gestures to this individual. Assuming that the benefits of these lost altruistic acts outweigh the costs involved in reciprocating, the cheater will be selected against relative to individuals who, because neither cheat, exchange many altruistic acts."^{3,6}

Another explanation is that, in response to the cheats' 'bad will', the altruists evolve an ability to defend themselves:

"Once strong positive emotions have evolved to motivate altruistic behaviour, the altruist is in a vulnerable position because cheaters will be selected to take advantage of the altruist's positive emotions. This, in turn, sets up a selection pressure for a protective mechanism."⁷

These monitoring shields were the result of a brain physiology and are moral emotions, such as indignation, embodied, some believe, before morality was even possible:

"... the reason the moral emotions had to come about was to keep the adaptive behaviour of altruism working in the face of the equally adaptive behaviour of cheating. Once the behaviour of altruism had entered our ancestral species' gene pool ... it was inevitable that the behaviour of cheating would also come about."⁸

Tenaciously, and quite conveniently for the evolutionary story, cheats, recognizing that they no longer rule the roost, and are being denied benefits they formerly could easily swindle from non-cheats, may even swap sides and become altruists, of sorts. According to Trivers, some cheats may become pseudo-altruists to deceive genuine altruists all over again: "Once friendship, moralistic aggression, guilt, sympathy, and gratitude have evolved to regulate the altruistic system, selection will favour mimicking these traits in order to influence the behaviour of others to one's own advantage."⁹

The mystery of first appearance

In such just-so stories, it is unsurprising that reciprocal altruism becomes fixed and dominant, and cheaters are rare. However, as many have pointed out, the real problem is how the altruistic gene was not eliminated on first appearance. Trivers, in a moment of plain speaking regarding his idea's shortcomings, nevertheless falls back onto the omnific powers of circular reasoning:

"There is no direct evidence regarding the degree of reciprocal altruism practiced during human evolution nor its genetic basis today, but given the universal and nearly daily practice of reciprocal altruism among humans today, it is reasonable to assume that it has been an important factor in recent human evolution and that the underlying emotional dispositions affecting altruistic behaviour have important genetic components."¹⁰

E.O. Wilson admits frankly to the problem: “How critical frequencies [of an altruist gene] are attained from scratch remains unknown.”¹¹ Faced with the logically insurmountable, Wilson believes that the answer must lie out there, somewhere, and then throws into the mix all candidates:

“The machinery for bringing the gene frequency up to the critical value [over which it isn’t immediately eliminated] must lie outside the game itself. It could be genetic drift, which is entirely feasible in semiclosed societies, or a concomitant of interdemic or kin selection favoring other aspects of altruism displayed by the cooperator genotypes.”¹²

In developing their models, theoreticians take for granted the already established presence of altruism genes. At once both question-begging and tautological, the maths posits “a nonzero frequency of helpers above which selection tends to increase their frequency, and below which selection tends to decrease their frequency.”¹³ In further tautological clarification, in order for the gene to spread, the number of helpers must be greater than a ‘sociality threshold’. In other words, once an exceptionally rare (and theoretical) altruistic allele proliferates to the extent it can keep on increasing in numbers, it will continue to multiply.

Theoreticians habitually use abstruse language to mask their failure to adequately explain their case. For example, Brown *et al.*, addressing Boorman and Levitt’s work (see below), state:

“[the authors] demonstrate the existence of a threshold value of the social allele which must be overcome for sociality to evolve. Since this threshold frequency would usually prevent takeover by a rare mutant allele, the authors suggest the ‘takeover cascade’ as a plausible mechanism for successful invasion, whereby population viscosity would allow the social allele to first establish itself locally and then slowly invade neighboring populations.”¹⁴

Suggesting a rare-as-hen’s-teeth altruistic allele could eventually conquer its own territory, and then its enemies’, by virtue of their model allowing it, is not a heuristic exercise; it’s a smoke and mirrors word feast.

As for Boorman and Levitt’s paper, the authors give life to a much needed altruistic insurrection by arguing that if an altruistic allele is a homozygous recessive (hr) and that not meeting another hr is lethal, then one hr linking up with another will be a fitness-enhancing event because cooperation will necessarily take place.¹⁵ Given the fundamental rule of deductive logic that there is nothing in the conclusion that isn’t already contained in the premises, Boorman and Levitt’s model doesn’t appear to challenge that modest truth.

Suggested models unfailingly rely on a series of unreasonable assumptions designed to break through this imagined threshold. For example, populations are of infinite size,¹⁶ have the population subdivided,¹⁵ have interactions between individuals occurring on a non-random basis, meaning an unrealistically high frequency of helpers aiding other helpers,¹⁷ have near-perfect memory of encounters with cheaters,¹⁸ or ensure altruists rarely interact with strangers.¹⁹ It would seem that such models hardly reflect real-life situations in which people are more likely to be members of large populations where interactions are entirely random and little is known about the other, particularly in one-off meetings.

Occasionally arguments are put forward containing an already conveniently propitious disposition. Peck and Feldman acknowledge that previous models involving large, randomly mixed populations cannot raise the level of helpers from the initial low frequencies. They concede that their “intention in presenting the model is not to suggest that the performance of helping behavior should be a ubiquitous phenomenon in natural populations, but to identify a set of biologically reasonable circumstances which, when they occur, favour the evolution of helping behaviour.”²⁰

Reciprocal altruism isn’t really

Let me restate the obvious. Trivers’ altruism bears no resemblance to ordinarily understood altruism in which expectations of return are absent from any interaction with another. Reciprocal altruism is merely a *quid pro quo* contract, and this species demands a return for its investment. Giving without receiving makes no sense in an evolutionary world where the highest ideal is the perpetuation of one’s gene pool.²¹

Dennett, however, argues that objections to this entirely miss the point. Reciprocal altruism, rather than being the full-blown ‘left-hand-not-knowing-what-the-right-is-doing’ altruism, is a transitional phenomenon that serves as “a useful stepping-stone on the progression” to the real deal (or as he calls it, the ‘real McCoy’).⁴ Not realizing his self created chicken-or-egg problem, Dennett dodges the problem of self-serving behaviour becoming its opposite. Critics have underscored the unbridgeable difference between the two. In his response, Dennett argues that once a creature acquires “advanced cognitive abilities—a rather specific memory capable of reidentifying one’s debtors and creditors, and the capacity to spot a cheat”,²² the difficulty just vanishes.

Yet, without so much as a hint of shame, Marc Hauser sums this up:

“When we lack kinship, we act nicely if we have some guarantee of a reciprocated return. This isn’t an act of kindness. Reciprocity is an act of self-interest, because it is driven by the expectation of a fair return:

food for food, backrub for backrub, babysitting for babysitting. From the gene's-eye view, the way to think about the evolution of moral behaviour is to think selfishly. Instead of asking 'How can I help you?' ask 'How can my helping you help me?' In the simplest case, you would compare two strategies, moral versus immoral, and tote up the number of babies for each. If the moral strategy wins, both in terms of reproductive output and in terms of its immunity to immoral invaders, then selection will favour the moralist and eliminate the immoralist. Life isn't that simple, but the logic of the argument is."²³

A world according to Hauser, if true, is a world which few would prefer to live in, and Michael Ghiselin's now infamous comment "Scratch an 'altruist' and watch a 'hypocrite' bleed"²⁴ would arguably sum up reality more frighteningly and accurately.

And this dystopian vision is that of two famous sociobiologists. Repudiating a realist moral objectivity, Ruse and Wilson draw upon reciprocity, but a nuanced 'genteel' one:

"... the expectation [of reciprocity] does not necessarily employ a crude demand for returns, which would be antithetical to true morality. Rather, I expect you (or God) to help me because it is right for you (or God) to help me, just as it was right for me to help you (or obey God). The reciprocation occurs in the name of morality."²⁵

But theirs is a crude caricature of genuine morality. Both 'demand' and 'expect' have the same ontological function. Without an external moral objective base, something both deny, the *quid pro quo* transactions based on these being

'right' is nothing but a non-cognitivist²⁶ prescriptive meta-ethic wanting something, eventually, in return for being 'good'.

Winning is not the most important thing; it's how you play the game

So how could kindness for kindness's sake, real altruism, take a first step? In the late 1970s Axelrod²⁷ set up a computer tournament and asked people to design programs which represented the way creatures related to each other. *Tit for Tat*, the most successful, operated on an antithetical Golden Rule principle of being initially nice and then subsequently mirroring the response of the other. Wright, explaining *Tit for Tat*, describes it as "do[ing] unto others as they've done unto you".²⁸ Consequently, if the other returned nastiness, you reacted identically; if you received a kind approach, you returned the favour. The game was lauded as a demonstration of how a population of 'altruists' couldn't be invaded²⁹ and thus the population could continue to operate as an evolutionarily stable strategy (ESS).³⁰ Selfish cheats were excluded, and gracious bodies were brought in by cooperating until the cheats had to change to survive. The significance of an ESS was that it could, so it was suggested, explain cooperative behaviour without calling upon higher levels of selection.

Of course, the resemblance to altruism, the initial kindness, is hardly convincing—it was already present from the beginning as a result of being introduced as part of the program. From a computer program, Janet Richards makes the leap to full-blown altruism by claiming, "the details are not essential to our purpose here, which is simply to answer the claim that evolution cannot produce unselfishness."³¹

Faced with a complete disjunct between the indulgences of the theoretical and the clarity of the real, some opt for the optimism of fideism. Dennett well understands the complexity of simulating our ancestral struggles toward morality. The problems are exceedingly compound, yet he nevertheless encourages us to believe there are evolutionary solutions because "We may be quite sure that [the existence of such an evolutionary explanation] is true, for here we are."³²

Kitcher likewise ignores important issues such as the origin of the underlying genetics and the unlikelihood of two similar altruistic alleles arising at the same time: "provided that we have a pair of DA [discriminating altruist] mutants, discriminating altruism can invade a population of defectors."³³



Image Composite of images by Ron Lach, Pixels.com

Figure 3. The Prisoner's Dilemma: confess to the authorities, inculcate your partner as the sole culprit, or remain silent?

DAs are not pure altruists but will interact with someone as long as they haven't previously defected on a DA. In other words, they are unforgiving. Kitcher's elaborate equations, contrived to calculate payoff values, strain to obtain traction in explaining genuine altruism or what he calls 'hyperaltruism'. The best is an admission that "we seem to have shown that selection will favour 'golden-rule' altruism of a discriminating kind (treating the other as oneself so long one has no basis for thinking that the other will not do the same)."³⁴ Isn't this nothing more than a well-weighed you-scratch-my-back-if-I-scratch-yours interaction? In a disingenuous admission of defeat for his reductionist maths, Kitcher limits the real-deal altruism, what he calls 'the more subtle forms', to that "portrayed by historians and writers of fiction".³⁵

Smith draws attention to problems in the simple representation of game theory³⁶. He concedes that strategies played out with only two genetic polymorphisms are far more manageable and analyzable than ones with more than two. His modelling assumes asexual inheritance and, if reformatted for sexual reproduction, depends on an ESS being produced through a homozygous genotype. More complications arise in asymmetric contests where participants possess unequal characteristics, such as differences in sex, size, and age. Also, where there are more than two engaged at any one time this increases the complexity of strategy determination.³⁷

Other game theorists have grappled with the difficulty of altruism's spread among unrelated individuals. If you knew beforehand how another would relate to you, then you would know if an alliance would enhance your fitness or reduce it. Trying to predetermine the strategy of the other player is termed 'the problem of common knowledge' in which the action the other chooses depends on what she thinks you'll do, which depends on what you think she'll do ... and so on. Calculating the possibility of someone's cheating or honesty, on this infinite regress scenario, means there is no best strategy, and if so, morality would seem that much more unlikely to have arisen. But, of course, we do demonstrate other-concerning action and trust toward non-kin, and so theorists came up with the Prisoner's Dilemma (figure 3).

Rats always win ... well, almost always

Imagine the following scenario. You are arrested with a friend and accused of a serious crime. The arresting authorities have less than certain evidence but are relying on one of you ratting the other out. Separated, neither you nor your friend have any idea how the other will respond when interrogated. If both of you keep silent, each will receive a moderate sentence; if both finger each other, slightly more; and if one admits nothing while the other says the first committed the crime, the silent one gets hit with the

severest of sentences while the rat gets off scot-free. What's the best course of action?

From any one individual's perspective the best outcome is to cheat and blame the other. As a pair, however, it's to cooperate with each other and not confess in order to receive the lightest of sentences. Of course, one cannot be guaranteed that the other will not cheat because one cannot know, hence the dilemma. Thus, no matter what the other does, in terms of pay-off, the best strategy is to cheat and to pursue your own self-interest, at least for one-off interactions.³⁸

Single encounters raised a significant problem. The maths meant it would be impossible for cooperation and altruism to arise if meetings were single, period, because the strategy of always defecting would produce an uninvadable population utterly resistant to a good guy's charms. In other words, the cheat will never transform to an altruist because he quickly moves on to swindle yet another sucker. To remove this obstacle, evolutionary strategists claimed, perhaps realistically, that a considerable percentage of our interactions are not one-off but multiple, and often with the same person. Once the assumption that the number of games is not fixed is removed, thus generating the idea that there is a reasonable probability there will always be another game, an ESS will arise from the application of a *Tit-for-Tat* response.³⁹

Prisoner Dilemma-styled scenarios have not escaped criticism, particularly when they're brought in as a basis to understand the real-life problem of morality's rise. Shortcomings include the mandatory concomitant development of players possessing the necessary machinery and genetics to store and process memory of participants and outcomes,⁴⁰ learning capacities, the problem of the co-evolution of the communicative abilities between sender and receiver, the unpredictability of winners, and the crudeness of measures of behaviour "with no regard for subtle gradations, intervals between events, repetitions of events, proximity of interactants and their orientations, or context."⁴¹ Barlow and Rowell concluded their paper with the following candid comment: "The bottom line is whether the game theoretical approach has led to useful new predictions, to unanticipated hypotheses to be tested. Our assessment is that so far it has not."⁴²

Others have discovered that limited environmental cues, the inability to process information in a consistent way, information overload and fatigue can bring about mistrust and thus affect decisions even in initial interactions. Einhorn further doubted whether the usual explanation for the first cooperative response in *Tit-for-Tat*, one motivated from pay-off calculations, is always adequate. After all, according to the devotees of *Tit-for-Tat*, testing the waters by being nice on the first encounter is a dominant strategy. Dominance occurs when a participant's response is the best tactic for

that player no matter how the other plays. However, Einhorn noted the possibility of the unintentional reaping undeserved rewards: “It would seem that one also needs to include a probability of choosing the cooperative response of error.”⁴³ He was also critical of the superficiality of evolutionary game theory: “the major limitation of game theory in describing the evolution of behaviour lies in its static formulation of the process.”⁴⁴

Johnston pointed out that evolutionary game theory addressed the interaction phase to the exclusion of how the variations arose in the first place. He showed how theorists create technical jargon to circumvent problems of origins. Installing the appropriate genetic variability from the beginning is easy when terms like ‘mutant strategy’ or ‘incipient variations’ are buried within an explanation.⁴⁵

Some don’t bother concealing their weighted conditions. One paper, without warrant, includes a genetic predisposition to indiscriminately assist. This theoretical structure then immediately ‘learns’ to discriminate against non-reciprocators. This skill comes not from a single allele but “generalized traits such as enhanced memory”, and as a result reciprocal altruism becomes widespread.⁴⁶ Similarly, Hamilton and Axelrod, following a highly phrenetic theoretical brief about variations of games, postulate: “Once the genes for cooperation exist, selection will promote strategies that base cooperative behaviour on cues in the environment.”⁴⁷ In combination with a dazzling series of matrices, equations and application of game theory, they assign ‘arbitrarily low initial frequencies’ of helpers that increase in numbers, making no mention of just how the ‘helpers’ came into existence. Apparently, they see nothing

prejudicial about including several good Samaritans *ab initio*.

Furthermore, a population of egoists is an evolutionarily stable strategy and can never be invaded by a co-operative one, even a *Tit-for-Tat* one. Some games actually do produce better yields for selfish participants. One such experiment “highlight[ed] the possibility that the selfish behaviour of psychopaths can lead to greater short-term rewards than pro-social behaviour [and if] psychopaths notice this advantage, this very experience may act as a reinforcement of antisocial behaviour.”⁴⁸ Extending the question-begging further, to get reciprocal altruism over the theoretical hurdle, interactions between individuals must occur repeatedly, a faculty for discriminating against cheaters and recognizing conspecifics must be up and functioning, as well as a mechanism to suppress or avoid the choice of accepting aid but not returning it. Still, this form of altruism promoted by its adherents bears no resemblance to the biblical understanding of good will to your neighbour or, indeed, to your enemy. Co-operative strategies such as Prisoner Dilemmas and *Tit-for-Tat* are, as O’Hear remarks, “very far from genuine altruism, or from morality at all ... [and] are clearly for the mutual self-interest of the parties involved.”⁴⁹

Let me recap. From one perspective, game theory is intricate and well-honed. From another, however, it only successfully satisfies the evolutionary mind due to a smoke-and-mirrors strategy of question begging into existence the parodies of altruism. Dennett’s circularity of argument is worth repeating: interaction strategies of these computer simulations of morality’s development more or less accurately reflect evolutionary history and present reality because “here we are [today]”.³²

Conclusion

Evolutionists faced a counterfactual: how can neo-Darwinism, the aim of which is to place more of one’s genetic material into one’s flesh-and-blood posterity, account for acts of kindness which extend far beyond consanguinity? Such good deeds were counterintuitive to evolutionary expectations and yet Good Samaritan acts do occur.

Trivers, however, raised the possibility of unconscious *quid pro quo* acts through his reciprocal altruism explanation. He imagined that a good turn by an actor ‘deserved’ to be returned by its recipient to some needy other at a later date and place.



Image: Muhammad Mahdi Karim, Wikimedia / GFDL 1.2

Figure 4. Parasite removal is often mooted as an example of reciprocal altruism, but the actual calculation of pay-off reward and reciprocation is too complex

This altruistic mentality would spread throughout the population and become, ultimately, a potential pay-off for the initial cost of the actor's assisting the recipient as well as a future corporate benefit to the larger community.

The problem of the parasitical cheater was exposed, and the best evolution proponents could offer was that the rogue, if he didn't reform his swindling ways, would be frozen out of 'polite' society and left to defend for himself.

Notwithstanding these 'cavils', the most vexing hurdle remained: where is the original allele(s) that directs an individual to rise above selfishness and by what process did it come into existence?

Desperate to overcome the mounting counterarguments, game theory was exploited to vindicate, at least in theory, how individual acts of altruism could develop and spread. The relevance of this to real life scenarios was thin at best.

Once again creationists have nothing to be troubled about. Evolution's materialist quiddity continues its (failed) battle to unseat ethics' essence; namely, it's very much non-natural ontology.

In the next part, I will continue the analysis of reciprocal altruism and its almost complete reliance on animal studies. Evolutionists appreciate it is far too problematic for morality to have arisen in humans *de novo*. Consequently, it is expected animals possess a kind of proto-morality.

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- See, for example, many of the expectations in Axelrod, R., *The Evolution of Co-operation*, Penguin, London, 1990.
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- Peck and Feldman, ref. 13, p. 210.
- I might add here that even without the 'science' running alongside these claims, logically a non-theist has few options open to her and this 'enlightened' self-interest seems the only way to go. For example, Albert Ellis has attempted to defuse criticisms of the humanist ethos as selfish and narcissistic by spelling out that their belief "primarily strive[s] for one's own satisfactions while, at the same time, keeping in mind that one will achieve one's own best good, in most instances, by giving up immediate gratification for future gains and by being courteous to and considerate of others, so that they will not sabotage one's own ends" (Ellis, A., *Reason and Emotion in Psychotherapy*, Lyle Stuart, Secaucus, New Jersey, p. 134, 1962, as cited in: Watson, P.J., Hood, R.W., and Morris, R.J., Religious orientation, humanistic values, and narcissism, *Review of Religious Research* 25(3):257–264, Mar 1984; p. 258.) 'Unremarkably', Watson *et al.*'s study concluded that "humanistic self-actualizers may appear more vulnerable [to narcissistic self-concern] because they lack beliefs that actively suppress this characteristic ... [while] an emphasis on values associated with intrinsic religiosity may combat a self-gratification[sic] that humanistic belief systems fail to influence one way or another." *Ibid.*, p. 263.
- Dennett, ref. 4.
- Hauser, M.D., *Moral Minds: How nature designed our universal sense of right and wrong*, HarperCollins, New York, p. 312, 2006. It would become extremely tedious, not to mention repetitive, if I were to mention every time an evolutionist entirely begs the question of what moral behaviour is by reducing it to an action which increases differential survival or reproductive capacity. Nevertheless, Hauser clearly has this in mind. Incidentally, at risk of being accused of churlish *schadenfreude*, it has come to my attention that Hauser, a (former) distinguished Harvard professor, has been found guilty of scientific misconduct (i.e. cheating) by fudging his data. Hauser resigned his professorship in 2012 when "it was revealed that after an internal investigation, a committee had found the popular psychology professor 'solely responsible' for eight instances of academic misconduct in three published articles." See thecrimson.com/article/2013/9/27/mark-hauser-publishes-book, accessed 6 Jan 2021). And, "After a two-year federal investigation, the Office of Research Integrity found former Harvard psychology professor Marc D. Hauser responsible for six counts of research misconduct, including fabrication of data, doctoring of results, and misrepresentation of research methods in his Harvard lab." See Patel, A.H., Marc Hauser, Former professor found guilty of academic misconduct, publishes first book since resignation, *The Harvard Crimson*, 27 Sep 2013, thecrimson.com/article/2012/9/6/hauser-misconduct-investigation, accessed 6 Jan 2021). See Smith, D., Scientist guilty of misconduct, *The Sydney Morning Herald*, p. 3, 23 Aug 2010. Hauser has recently published a book with what would seem the exculpatory title *Evilicious: explaining our evolved taste for being bad*.
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26. Non-cognitivism maintains that there are no stance-independent ethical facts denoting objective right and wrong.
27. For the most thorough explanation of Axelrod's project, see Axelrod, ref. 18. Game theory was first formulated as a branch of mathematics by John Von Neumann and Oskar Morgenstern. It seeks to model interdependent situations in which strategic choices are determined in part by one person and in part by another or others. See William Poundstone's fascinating biography on Von Neumann, *Prisoner's Dilemma*, Anchor Books, New York, 1993.
28. Wright, R., *The Moral Animal*, Abacus, London, p. 127, 1994. Such description captures just enough biblical flavour as to beguile the unwary. It gives the impression that it could have been something Christ said. However, it's quite clear that He said nothing like this, but, in fact, one could say He said the exact opposite. While Wright's is a reactive normative principle, Christ's was the more difficult approach and was proactive in the sense that as we would have people do to us, we should first treat them thus, and always so. The two principles are antithetical to each other and consequently have nothing in common.
29. In game theory, a population that can be invaded is one in which a mutant new strategy entering the population receives a higher payoff when engaging with a native, a typical member of that population, than a native gets engaging with another native.
30. An ESS is one which maintains a society as uninvadable; that is, if all members of the society are using it, no other strategy is fitter.
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32. Dennett, ref. 4, p. 480.
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35. Kitcher, ref. 33, p. 514. It's noteworthy that Donald Campbell, in an otherwise mostly unprepossessing paper, lambasts the practitioners of this type of enterprise in which personality characteristics such as altruism, spite, jealousy, and deceit are determined by specific genes. He marks it as "a style of armchair psychologizing that these highly scientific geneticists have fallen into [which] can be easily dismissed as mathematized and computer-assisted armchair psychology." Campbell, D.T., On the conflicts between biological and social evolution and between psychology and moral tradition, *American Psychologist* 30(12):1103–1126, Dec 1975; p. 1110.
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37. Maynard Smith, ref. 36. Smith elsewhere notes that pleiotropy "is assumed not to operate and strategies are allowed to replicate independently of each other." (Parker, G.A. and Maynard Smith, J., Optimality theory in evolutionary biology, *Nature* 348(6296):27–33, 1 Nov 1990; p. 31.)
38. Worthwhile explanations of the dilemma are found in Axelrod, ref. 18 and Ridley, M., *The Origins of Virtue*, Softback Preview, pp. 53–66, 1997.
39. Arguably, the most serious flaw in these models is, as Axelrod indicates, that defection on both a single encounter and the last of a known number of interactions prove to be optimal for all parties and the only evolutionarily stable strategy. Both events will inevitably produce a population of defectors. See Axelrod, ref. 16, pp. 92–93.
40. See, for example, Rothstein and Pierotti's simultaneous expectation of a helper possessing the genetic wherewithal to be altruistic and the discriminatory apparatus of detecting cheats in Rothstein, S.I. and Pierotti, R., Distinctions among reciprocal altruism, kin selection, and cooperation and a model for the initial evolution of beneficent behavior, *Ethology and Sociobiology* 9(2–4):189–209, Jul 1988. In case I should be accused of misrepresenting the article, given its titular promise of supplying a model for the 'initial' evolution of altruistic behaviour, I reread the article, and all I could conclude was the authors were being disingenuous because 'initial' really meant 'once it is established' (p. 191).
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42. Barlow and Rowell, ref. 41, p. 103. See Maynard Smith's reply, Game theory without rationality, *The Behavioral and Brain Sciences* 7(1):117–125, 1 Mar 1984; p. 119ff.
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44. Einhorn, ref. 43, p. 104. For other criticisms concerning the relevance of game theory to real life see Malone, J.C., Jr, Evolutionary game theory: suddenly it's 1960! (or is it 1860?), *The Behavioral and Brain Sciences* 7(1):112, 1 Mar 1984; Rothstein and Pierotti, ref. 40. Joyce lists several weaknesses of Tit for Tat (TFT) and comments that the "triumph of TFT is entirely the result of the way the game has been set up, and there are a number of reasons for thinking that the rules of the game fail to model many aspects of real-world reciprocal exchanges." Joyce, R., *The Evolution of Morality*, The MIT Press, Cambridge, MA, p. 28ff, 2007.
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49. O'Hear, A., *Beyond Evolution: Human nature and the limits of evolutionary explanation*, Oxford University Press, Oxford, p. 105, 1999. Disturbingly, there's a vocal minority of academics who argue that cheaters are an evolutionary adaptation—and a worthwhile and even successful one at that. See, for example, Harpending and Sobus, ref. 6, and Krupp et al., Nepotistic patterns of violent psychopathy: evidence for adaptation, *Frontiers in Psychology* 3:1–8, Article 305, 28 Aug 2012 | doi.org/10.3389/fpsyg.2012.00305, accessed 7 Sep 2021. Sociopathic behaviour of having multiple female partners producing many offspring, i.e. cheating, is seen as an adaptive evolutionary strategy rather than maladaptive and thus needs no reciprocal relationships. See MacMillan, J. and Kofoed, L., Sociobiology and antisocial personality: an alternative perspective, *J. Nervous and Mental Disease* 172(12):701–706, Dec 1984.

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What's wrong with being wrong: part 4b—a more than cursory look into evolutionary ethics

Marc Kay

In part 1, I examined problems associated with using evolution, a materialist philosophy, to explain ethics, a non-material discipline. Subsequent discussion addressed the failure of group selection and kin selection to clarify how morality came to be. This part continues the critique of reciprocal altruism. Evolutionary dogma logically demands a biological continuum from non-human life to the human. Consequently, reciprocal altruism is almost totally reliant on evolutionists' belief that animal studies demonstrate a proto-morality.

It's all down to the relatives

In 1838, some twenty-one years before he published *On The Origin of Species*, Darwin penned the following: “Man in his arrogance thinks himself a great work. Worthy the interposition of a deity, more humble & I believe true to consider him created from animals.”¹

Darwin needed to demonstrate that human morality originated in animal behaviour and was not, as was then near universally held, an aspect of man mirroring the divine image.² To this end, his *The Descent of Man* contained a lengthy catalogue detailing the physical and mental similarities between animals and man. These provided an empirical and protreptic base for the fourth chapter, solely devoted to the origin of human morality. Darwin's linking humans to animals was the watershed moment for a new vision of the world and ourselves.³

It comes as no great surprise, then, that contemporary evolutionists underscore their claims for reciprocal altruism being an ancestral bridge to psychological altruism by pointing to animal behaviour examples which appear to be acts of kindness. The animal rights activist and Princeton philosopher Peter Singer (figure 1) unpacks the logic behind this:

“... if the origins of ethics lie in a past which we share with many non-human animals, evolutionary theory and observations of non-human social animals should have some bearing on the nature of ethics ... [And conversely] Understanding the development of altruism in animals will improve our understanding of the development of ethics in human beings, for our present ethical systems have their roots in the altruistic behaviour of our early human and pre-human ancestors.”⁴

As one author uncompromisingly put it, “Attempting to unhook all our links to the animal kingdom would constitute a costly conceit.”⁵

Although now regarded more accurately as mutualism, the cleaner wrasse found in the mouths of larger fishes are serially paraded as representative of reciprocal altruism.^{6,7} Such intricate behaviour, it is contended, was brought about by selection, despite conceding that originally the larger fish would have immediately eaten the much smaller. How would such symbiosis get off the ground? It's clearly a case of all or nothing and no Dawkins' one-percent-success-is-better-than-nothing explanation could logically fit. Yet, with no incremental steps available to scale this Mount Improbable, evolutionists routinely turn toward the god of exigent necessity by simply invoking its appearance: “[The cleaner fish] have developed behavioural signals that simply shut down the aggressive impulses of the cleaned fish.”⁸ Williams unilluminatingly calls the arising of such mutualism a “chance relation [though] relatively rare, and it must be that these necessary preconditions seldom arise.”⁹

As an example of reciprocal altruism, Trivers proposed alarm calls from birds alerting others in the flock to the existence of a predator. It's been pointed out, however, that Trivers' example isn't a genuine type of reciprocal altruism because there is no fitness cost to the caller and no genuine exchange. Although the call may dissuade the predator from returning to hunt on any subsequent occasion, the caller itself will be less likely to be killed by the same predator.¹⁰

More promising evidence for reciprocal altruism is found in higher primates.¹¹ The reasoning, stripped of any abstruseness, is uncomplicated. Evolution is incrementally slow, and since morality is an important biological strategy for survival—it supposedly increases reproductive success—behaviour suggestive of it (often labelled ‘proto-morality’) should be found in our close relatives. This would support the proposition that morality, and altruism specifically, has



Image: Crawford Forum, Wikimedia / CC BY 2.0

Figure 1. As a consequence of his evolutionary worldview, philosopher and animal rights activist Peter Singer must extend ethics to the non-human world. He admits this creates cognitive dissonance when he finds it difficult to decide whether rats' interests are to be considered even when they bite and infect children in the slums.

a biological foundation. Devoid of restraint, this project understands well its mission, as reflected in Gallup's words: "Primate research poses one of the greatest contemporary threats to traditional notions about man."¹²

Ruse draws from de Waal's studies in which a mother chimp notices her child fighting another. The mother wakes the nearby sleeping oldest female and this senior makes threatening noises and gesticulations to halt their fighting. Ruse then asks, "If this [quietening influence] is not ... act[ing] as a moral force—or, let me say cautiously, a proto-moral force—I do not know what is. 'Blessed are the Peace-makers: for they shall be called the Children of God'."¹³ Chimps kissing and embracing after fights serves to preserve peace within the community and are thus proposed as mechanisms that eventually led to morality in humans.¹⁴ De Waal admits that reconciliation and forgiveness are not synonymous but argues that the two are related. Perhaps an alternative explanation is that these may be better understood as instrumental means to a non-moral end; problem-solving

exercises designed to bring peace and quiet to a community, not morality.

Exchanges of food or grooming in animals are commonly cited as strong indicators of reciprocal altruism. The return of favour, sometimes many hours after the initial act of feeding or grooming, is labelled by many evolutionary behaviourists as 'gratitude', something which is deemed essential for human morality.¹⁵

A brief excursus to ethical philosophy

It is important to recall precisely what morality involves: the non-instrumental 'ought' component. Gratitude has nothing particularly moral about it unless it is accompanied by a sense that one should thank the other person or, in the case of apes, return the favour with some conscious deliberation that if one did not, it would be wrong; i.e. wrong in a non-expedient or non-instrumental sense.¹⁶ It seems unlikely an ape would be able to self-reflect to the degree of critically analyzing its own behaviour and feel the pang of conscience it had acted inappropriately and broken a moral dictum like, "It is morally reprehensible to not demonstrate gratitude when a favour is done for you."

Moral philosophers place themselves in one of two camps: moral judgements are either controlled by the emotions or cognitive mechanisms. References to Hume, an 18th-century proponent of the former,¹⁷ litter evolutionary ethical explanations, and De Waal relies heavily on him. De Waal's thesis turns on a set of propositions: morality is reducible to an emotional aspect of behaviour; emotional behaviours like empathetic reactions and reciprocated favours appear to be displayed in animals; these, then, are strong evidence evolution via natural selection has preserved the same behaviours in humans and the non-human examples are the antecedent source for human morality. The argument is that there are essential behaviours and processes which must accompany moral behaviour for it to be called moral. If these are found in animals, there is no great gap to overcome in explaining psychological altruism in humans.

This evolutionary explanation unmasks several conceptual errors. It confuses morality, *qua non* instrumental rightness and wrongness, with the flow-on behaviours, responses, and reactions. It also seems to blur the line between necessary and sufficient components. Empathy, apparent or actual, while necessary, is not sufficient for morality and is certainly not synonymous, something De Waal does concede.¹⁸ Nevertheless, he appears to ignore his own principle:

"In human behaviour, there exists a tight relation between empathy and sympathy, and their expression in psychological altruism. It is reasonable to assume that the altruistic and caring responses of other animals, especially mammals, rest on similar mechanisms."¹⁹

This error is compounded by confusing effects with causes. Being in possession of true morality means being aware of a compelling ‘ought’. It is this which is the engine that acts as the cause for these behaviours, not the reverse, no matter how tight a relationship the two fields have with each other.²⁰

Language misappropriation

One major criticism of these studies is that many scientists anthropomorphize animal behaviour, particularly in the higher order primates. For example, they may talk about chimps’ ability to ‘deceive’, ‘plan’, or possess a sense of ‘humour’ or ‘honour’. In and of itself this is not particularly misplaced when it’s used for a pragmatic communication reason, but often it’s incorporated to tendentiously forge the evolutionary link between primates and humans. De Waal admits this:

“[Using anthropomorphic expressions] is hardly dangerous, though, to those working from an evolutionary perspective so long as they treat anthropomorphic explanations as hypotheses. Anthropomorphism is a possibility among many, but one to be taken seriously given that it applies intuitions about ourselves to creatures very much like us.”²¹

Once anthropomorphic language enters the academic argot, it is a small step to insert moral terminology as though one leads to the other. Singer routinely does this, and, given his publicly expressed views on animal welfare and the negligible difference between the human ‘animal’ and ‘other’ animals, it seems his ideology drives his conclusions. For example, from discussing what appears payback from one set of monkeys, ones who participate in delousing, toward non-participatory individuals, he jumps effortlessly to the claim that “more sophisticated reciprocators, able to think and use language, may regard reciprocity as good and ‘right’ and cheating as bad and ‘wrong’”.²² Apparently, Singer believes introducing inverted commas around crucial words replaces a science-based demonstration.

Wright commits the same error. Behavioural biologists will use emotive language to describe chimpanzees as ‘outraged’, ‘aggrieved’ or ‘insecure’ (e.g. “the chimps, upon dimly sensing their shared plight, developed friendly feelings, and attendant feelings of mutual obligations, that drew them into alliance.”²³) and cognitive language such as ‘anticipate’ or ‘plan’ (“the chimps saw that they shared a strategic interest and decided to form an alliance”²⁴). However, Wright insists that

“... it isn’t always clear from the behavioural evidence alone which kind of anthropomorphic language is in order. Fairly often, in both humans and non-human primates, a behaviour could in principle be



Image: Vera Kratochvil / Public Domain

Figure 2. Philosophizing or anthropomorphic imputation?

explained either as a product of conscious reflection and strategising or as a product of essentially emotional reaction.”²⁵

The ‘Theory of Mind’ and behind the mask

Often connected with the inclusion of anthropomorphic language is the attribution to non-human primates and humans of common mental states (figure 2). In other words, to some degree, the former also possess a ‘Theory of Mind’ (ToM). It is inferred from certain behaviours that a chimp, for example, conceives of another conspecific’s behaviour (or sometimes a human’s) in terms of a mental state. The individual animal is not just capable of first-order mental states, such as wanting and thinking, but being able to attach these states of mind to others, so called second-order states.²⁶ In order to impute moral deliberation to a creature, it is essential it possesses a ToM.

While there has been no shortage of quite elaborate experiments constructed to demonstrate both first-order and second-order mental states, the crucial underpinning is the background belief that primates and humans share common ancestry though an evolutionary lineage.²⁷ In addition is the metaphysical commitment to a principle of biological parsimony which dictates that, in this case, sharing of an evolutionary history entails possessing similar biological functions.²⁸ In order to provide any initial explanation, evolutionists are forced to erase or shrink the real distance between primates and humans.²⁹

Povinelli and Vonk, notwithstanding their expressed commitment to evolution, point out several fallacies involved in animal ToM studies. The chief criticism is the default position's authority that the animals' behaviour is a product of their assumed ability to form mental abstractions, no matter how many controls are put in place during the tasks. In other words, there is an overlooked circularity at the heart of how these experiments are designed.³⁰

Complex primate studies involving token exchange systems based on differential food rewards between paired animals produced quite startling emotional reactions from one animal when the other pair member received an 'unfair' distribution of rewards. De Waal admits that genuine recognition of unfairness would entail a favoured capuchin, the primate of choice in these matters, actually sharing the extra food with the less advantaged partner rather than the latter merely 'objecting' to not receiving an equal reward.³¹

Hauser, for a number of reasons, is critical of the structure and conclusions drawn from variations on this type of experiment. These objections include the assessment that some are really instantiations of mutualism due to the absence of any time delay between the initial instance of supposed altruism and its reciprocated act, and that the frequency of reciprocation is often predominantly dependent upon the quality of food on offer and the capuchins' ability to accurately recognize this. The artificiality of the experiments poorly reflects real-life conditions and the apparent absence in nature of capuchins working together for a common end.³²

Kitcher likewise doesn't find much to convince him that these capuchins are actually taking a stand against the lack of fairness. He sardonically states, "if the lucky capuchin were to throw down the grape until his comrade had a similar reward, that would be very interesting!"³³

Other experiments designed in such a way that one animal is electrically shocked or starved while another in an adjacent chamber isn't have this latter animal, it is supposed, responding with a proto-moral behaviour by exhibiting clear signs of distress or refusing to eat while its conspecific goes without. Prinz, going against this well-intrenched idea in moral evolutionary biology, attributes not empathy to these reactions but rather mere instances of, for example, a monkey reading the other's cry of pain as a warning sign of

imminent danger or experiencing vicarious distress because they were fearful that they too would be shocked or hung upside-down.³⁴ These goal-driven explanations of animal behaviour suffer from what Dennett branded "the incessant pull of generous over-generalization by human observers".³⁵

Seyfarth and Cheney point out that the putative mechanisms that support reciprocal altruism, like individual recognition, memory, identification of cheats and cost/benefit calculations, are exceedingly complex and themselves cry out for an explanation as to how they too could arise through evolution.³⁶ In addition, the authors grapple with the problem faced by observers in lab experiments concerning the sheer numbers of variables that would seem to resist cashing out in a common 'currency'. For example, how much value is placed on each component of an exchange by each individual? Is a single instance of an alliance against aggression equal to 20 sessions of flea-picking aid? And what is the duration of each? Despite the overwhelming and unyielding nature of the exercise, the authors are forever optimistic:

"We emphasize these problems not to argue against Trivers' theory or to dismiss our own [experimental] results, but instead to point out that the necessary conditions for evolution by reciprocal altruism—animals with long lifespans, low dispersal rates, high rates of interaction in stable social groups—by their very nature make quantitative tests of reciprocity theory extremely difficult."³⁷

Korsgaard alludes to the problem of other minds when raising the intrinsic difficulty of gaining access to an animal's mind and knowing what the real intentions are:

"A capuchin rejects a cucumber when her partner is offered a grape—is she protesting the unfairness, or is she just holding out for a grape? Do the chimps share food because they are grateful to those who have groomed them, or is it just that the grooming has put them in a relaxed and beneficent mood? ... The question of intention is a question about how an episode in which an animal does something looks from the acting animal's own point of view, whether it is plausible to think that the animal acts with a certain kind of purpose in mind. I think there is a temptation to think that the question whether we can see the origins of morality in animal behaviour depends on how exactly we interpret their intentions, whether their intentions are 'good' or not. I think that, at least taken in the most obvious way, this is a mistake."³⁸

Broom contends that the

"... complexity of reciprocation and the subtlety of the effects of some actions make assessing the magnitude of reciprocal altruism very difficult ... an individual may be motivated to show sympathy because of being disturbed by the sight or smell of blood."³⁹

There are a number of psychological prerequisites which must obtain for the idea of reciprocal altruism to be coherent and ‘a reciprocally stable relationship’. As Hauser points out, these include:

- the ability to recognize each other
- a functional memory to record and recall what was given, to whom and when it was given, whether it was given intentionally or as an accident arising from an intentional selfish act
- being aware of each other’s expectations
- appropriate emotional responses for violation of these expectations
- a psychological well-being
- empathy
- the ability to accurately predict another’s state of mind without directly experiencing their behaviour and
- the ability to establish, obey and enforce rules.⁴⁰

Other ascriptions of reciprocal sharing include blood regurgitation by vampire bats (figure 3) to others in the roost who were less successful accessing victims and who have been judged unrelated,⁴¹ tamarins, again manipulating tools which gave food to another, tit-for-tat guppies and pairs of blue jays participating in prisoner’s dilemma games. Hauser, critical of even his own work on the subject, sums up such supposed proof of animal reciprocity by stating that:

“Reciprocation in animals, if it exists, is based on a highly scripted text for how to interact in a particular context with a particular commodity over a short window of opportunity. As such, it lacks the generality and abstractness that typifies human reciprocation, as well as the potential to maintain the relationship with relatively long delays between reciprocated acts.”⁴²

If reciprocal altruism represents the ‘nice’ side of the animal world, then there’s also an inescapable dark side to it. Hrdy spent a considerable amount of her life studying langurs in India. She has documented the widespread existence of infanticide committed by conspecific males. These males attack and kill the offspring of other males and then quickly impregnate the females who have lost their children to these marauding males. The sexual selection hypothesis which accompanies her fieldwork argues that infanticide is an evolutionary strategy which gives an adaptive advantage to the infanticidal males.⁴³

Although higher-order primates have many features in common with humans, there are tremendous biological and genetic differences which controvert any mooted evolutionary linkage. Further, to attach, free of justification, an assumption that the ostensible like can be compared with like, and thus primate affective responses displayed are seemingly incipient or rudimentary acts of altruism, begs the question that animal experiments are apposite.⁴⁴ Humans are humans not because they share many similarities with, and have only a few differences to, chimps, but because they’re

uniquely different. This leads to an expectation that higher-order emotions and behaviours, like altruism, are unique.⁴⁵

Conclusion

There’s much at stake here. If it can be successfully, or at least forcefully, argued that our biological roots are located in an evolutionary animal ancestry, then it certainly impoverishes, if not destroys, a case for Christianity and its values. Dawkins argues evolution confers no special status on humans and leads to the dissolution of ethical absolutes. Far better than many Christians are able, he recognizes the significance of evolution’s reliance on a continuity between all of life:

“... there is no absolute distinction [and] absolutist moral discrimination is devastatingly undermined by the fact of evolution. An uneasy awareness of this fact might, indeed, underlie one of the main motives creationists have for opposing evolution: they fear what they believe to be its moral consequences.”⁴⁶

Theorizing that animals and humans are not separate but share space on a moral continuum raises a conundrum for the committed evolutionist. When conflicts of interest arise, how and by whom are rights distributed? There would appear to be no straightforward solution, particularly for the evolutionary vegetarian. Singer finds himself in an awkward position when he appears powerless to resolve this unproblematic pseudo-challenge: “What”, he asks, “are we to do about genuine conflicts of interest like rats biting slum children? I am not sure of the answer, but the essential point is just that we do see this as a conflict of interests, that we recognize that rats have interests too.”⁴⁷

It would be a foolishly brave evolutionist to argue that moral qualities arose *de novo* in humans, because this would signal some sort of extra-somatic source. Similarly, it would be an equally rash enterprise to contend animals possessed a fully developed morality. The third choice, and the only



Figure 3. Vampire bats involved in regurgitating blood to others in the roost is an example of reciprocal sharing.

Image: Oasalehm, Wikimedia / CC BY-SA 4.0

viable one available for the evolutionist, is to hypothesize that a proto-morality must have taken root at some time in prehuman ancestry. Reciprocal altruism (and kin selection) attempts to do just that.

The very real risk, though apparently ignored by evolutionists, is that they have defined morality out of existence by resetting morality as some other quality (for example, in terms of cooperative behaviour). This dark flip side to evolutionary explanations, as Rachels pointed out, means that “Man is a moral (altruistic) being, not because he intuitively feels the rightness of loving his neighbour, or because he responds to some noble ideal, but because his behaviour is comprised of tendencies which natural selection has favoured.”⁴⁸

If we allow these behaviours to be termed ‘morality’ in a very primitive sense, the problem arises that the individual is moral only in a very circumscribed manner. He is acting ‘morally’ to his kin or to outsiders with an expectation of return. Furthermore, there is no moral reason to act morally unless it is in his best interests to do so. Virtues are not universal but entirely contextually dependent and become “contractarian mutations of them”.⁴⁹ These deliberate twists prop up evolution because “they hide from view the degree to which [evolutionists’] proposals and analyses are revisionary of our normal moral consciousness.”⁵⁰

In the next part, I will describe other attempts to rationalize the rise of morality and altruism through evolution. In particular, I will examine E.O. Wilson’s sociobiology.

References

1. Darwin, C., *Charles Darwin's Notebooks, 1836–1844: Geology, transmutation of species, metaphysical enquiries*, Barrett, P.H., Gautrey, P.J., Herbert, S., Kohn, D., and Smith, S. (Eds.), Cornell University Press, Ithaca, New York, Notebook C196–197, p. 300, 1987. For a brief survey of Darwin’s early jottings on the continuity between man and animals see Degler, C.N., *In Search of Human Nature: The decline and revival of Darwinism in American social thought*, Oxford University Press, Oxford, p. 7, 1991.
2. Despite the occasional reference to deity and religion, Darwin unequivocally dismissed any sense of man’s having been created when his book concluded with the following: “Man may be excused for feeling some pride at having risen, though not through his own exertions, to the very summit of the organic scale; and the fact of his having thus risen, instead of having been aboriginally placed there, may give him hope for a still higher destiny in the distant future [despite] Man still bear[ing] in his bodily frame the indelible stamp of his lowly origin” (Darwin, C., *The Descent of Man*, Penguin, London, p. 689, 2004 (1879)).
3. However, note that the belief that man and apes were not as distant as the Bible states was not a novel idea. A century before Darwin’s publication, the atheist French philosopher Julien Offray de La Mettrie declared that apes could be taught to speak a language and be trained to become a man. According to his worldview, mental processes were natural processes of their material structures. For an insight to the pre-Darwinian intellectual environment at the time, see Toulmin, S., *Cosmopolis: The hidden agenda of modernity*, The University of Chicago Press, Chicago, 1990. On La Mettrie’s beliefs see esp. p. 122. If we’re referring to the book just cited (this reference), just “see esp. p. 122” should be enough. Although I can’t swear to its accuracy, a worthwhile summary of animal and human differences can be found in Lewis Wolpert’s *Six Impossible Things Before Breakfast: The evolutionary origins of belief*, Faber and Faber, London, pp. 51–68, 2007. In addition, Wolpert mentions some rather amazing skills displayed by, relative to the primates, quite lower order animals. My sneaking suspicion is that this was God’s way of eliminating any potential evolutionary hierarchical explanation for their acquisition.
4. Singer, P., *The Expanding Circle: Ethics and Sociobiology*, Clarendon Press, Oxford, p. 5, 1981. As a consequence of their overriding worldview, the eagerness (and thus their all-too-ready willingness to be blinded to the conceptual and scientific differences) of evolutionists to forge a genealogical link between the cause of animal and human behaviour can be easily understood by the putative existence of the so-called ‘warrior gene’. An allele that inhibited the production of an enzyme (monoamine oxidase A), which in turn caused an increase in serotonin (a neurotransmitter believed to play a key role in impulsivity and aggression), was identified in humans, transgenic mice and rhesus monkeys. A number of these studies ignored the clear but disconfirming role environment contributes to aggression and other antisocial behaviour, both in the human and animal experiments. For example, while promoting a strong correlation, even cause, between the genetic predisposition for MAOA reduction and aggression, Buckholtz and Meyer-Lindenberg nevertheless minimally grant that childhood maltreatment and socio-environmental factors are relevant considerations. Furthermore, they concede that the “inheritance of the MAOA-L allele is completely compatible with psychiatric health.” (Buckholtz, J.W. and Meyer-Lindenberg, A., MAOA and the neurogenetic architecture of human aggression, *Trends in Neurosciences* 31(3):120–129, Mar 2008.) This surely raises doubt as to any correlation or causative force of the genetic component if its appearance does not impose any psychopathology. Also see the non-predictive value of the genotypes associated with MAOA levels to violence and antisocial behaviours, and the confounding and unexpected results when race and environment were variables in Widom, C.S. and Brzustowicz, L.M., MAOA and the ‘cycle of violence’: childhood abuse and neglect, MAOA genotype, and risk for violent and antisocial behavior, *Biological Psychiatry* 60(7):684–689, 1 Oct 2006. For a critical overview of MAOA’s importance, or lack of, see Jalava, J., Griffiths, S., and Maraun, M., *The Myth of the Born Criminal: Psychopathy, neurobiology, and the creation of the modern degenerate*, University of Toronto Press, Toronto, pp. 157–161, 2015. Notwithstanding the contrary arguments, thinking as a Christian, and taking into account the tremendously life-altering physical effects of the Edenic Fall, it still may be the case that there is a link between mutation at the MAOA site(s) and increased levels of violent and anti-social behaviours.
5. Maletzky, B.M., Evolution, psychopathology, and sexual offending: aping our ancestors, *Sexual Abuse: A Journal of Research and Treatment* 7(4):243–248, Oct 1995; p. 245. Leaving aside the absurdity of its claiming any empirical cash value, in what must surely be an instance of grandiose inflated omniscience, Maletzky attaches the neologism ‘paleopsychology’ (p. 245) to the novel discipline which purports to peer a million or so years into the past and analyze the psyche and behaviour of the ‘prehuman hominids’. Yes, it’s easy enough to imagine homo-something-or-other lying comfortably supinely on a bed of granite explaining to his professional contemporary how ‘his’ psychological trauma is all down to his having come down from the trees to a savannah existence.
6. It is claimed that one distinguishing feature of genuine reciprocal altruism, absent from mutualism, is a significant time delay between the initial act of giving and the reciprocated payment. This provides ample opportunity for the initial donor to receive its return reward, thus demonstrating a ‘decision’ by the initial receiver of favour to act altruistically. Also, mutualistic behaviours are ones “that have a positive effect on the fitness of both”, distinguishing them from reciprocity as those that “have a negative effect on the fitness of the actor and a positive effect on the recipient”. (Boyd, R., Is the repeated prisoner’s dilemma a good model of reciprocal altruism? *Ethology and Sociobiology* 9(2–4):211–222, Jul 1988; p. 212.)
7. See Ruse, M., *Taking Darwin Seriously*, Basil Blackwell, Oxford, p. 226, 1987; Trivers, R.L., The evolution of reciprocal altruism, *The Quarterly Review of Biology* 46(1):39–43, March 1971; pp. 35–57. (Trivers, however, labels cleaning symbiosis a precursor to all-out reciprocal altruism.); and Barash, D.P., *Sociobiology and Behavior*, Hodder and Stoughton, London 1982.
8. Ruse, ref. 7, p. 226.
9. Williams, G.C., *Adaptation and Natural Selection: A critique of some current evolutionary thought*, Princeton University Press, Princeton, NJ, p. 247, 1966.
10. Koenig, W.D., Reciprocal altruism in birds: a critical review, *Ethology and Sociobiology* 9(2–4): 73–84, Jul 1988; p. 74. Various other mooted examples in birds, such as step-parenting, mate sharing and communal feeding, are analyzed in Koenig’s paper. Although suggesting reciprocal altruism may still be possible, Koenig concludes, “Reciprocal altruism theory has not fared well in the avian literature because of definitional problems and because it has been applied to many examples in which is [sic] only debatably appropriate This presents a considerable challenge to ornithologists, as there are currently no unambiguous examples of RA in this taxon” (p. 83).
11. See, for example, Ruse, ref. 7, p. 227ff. Notwithstanding the inevitable evolutionary cant and filter, much of the animal data, at first blush, seem to be straightforward and beyond reproach. However, in surveying the empirical studies designed to investigate whether or not chimps have, in part, a Theory of Mind (having a Theory of Mind means the individual possesses mental

- states that are capable of appreciating that others also have beliefs, desires, and intentions.), Hare *et al.* note the high number of negative results and the low replication rate between similar experiments. More interestingly for creationists is Hare *et al.*'s concluding comment that domestic dogs outperform chimps in being able to read human communication signalling the location of a hidden food resource. (Hare, B., Call, J., and Tomasello, M., Do chimpanzees know what conspecifics know? *Animal Behaviour* 61(1):139–151, Jan 2001.)
12. Gallup, G.G., Self-recognition in Primates: A comparative approach to the bidirectional properties of consciousness, *American Psychologist* 32(5): 329–338, May 1977; p. 329. The challenge goes even further, striking at the heart of Christian claims. Consider Oliver Putz's argument that, given the (supposed) ethological data of morality exhibited by chimps and the like, "a narrow anthropocentric understanding of the imago Dei is inadequate [and] warrants a more inclusive interpretation of the imago Dei To share with great apes in the imago Dei is neither removing human beings from our special relationship with God nor releasing us from our special responsibility toward the earth as a highly technological species. It is an expression of the abundant presence and richness of God's self-communication in the world." (Putz, O., Moral apes, human uniqueness, and the image of God, *Zygon* 44(3):613–624, Sep 2009; pp. 620–621.) Fortunately, Putz doesn't quite pull it off: his epistemological warrant precipitously favours a self-serving blend of postmodernism, mysticism, and metaphor.
 13. Ruse, ref. 7, p. 228.
 14. De Waal, F., *Primates and Philosophers: How morality evolved*, Princeton University Press, Princeton, NJ, p. 19, 2006.
 15. De Waal, ref. 14, p. 44. In any case, it is not entirely certain that grooming itself does not have an ulterior motive. DeVore reports that this act is not altruistic as the removed insects are edible and are apparently the real motivation for the grooming. Devore, I. (Ed.), *Primate Behaviour: Field studies of monkeys and apes*, Holt, Rinehart & Winston, New York, 1965: Cited in Aronfreed, J., The socialization of altruistic and sympathetic behaviour: some theoretical and experimental analyses; in: Macaulay, J. and Berkowitz, L. (Eds.), *Altruism and Helping Behaviour: Social psychological studies of some antecedents and consequences*, Academic Press, New York, p. 109, 1970.
 16. Irving Goldman astutely recognizes the problem here: "In all probability the search for a 'scientific morality' is a self-defeating endeavor. It will be self-defeating because a fully explained morality would be essentially expeditious. Morality and expediency are quite distinctive standards of conduct." (Goldman, I., The war between the words: biological versus social evolution and some related issues, *American Psychologist* 31(5):361–363, May 1976; p. 362.)
 17. Hume famously penned that "Reason is, and ought only to be the slave of the passions, and can never pretend to any other office than to serve and obey them." (*A Treatise of Human Nature*, book 2, part 3, section 3, J.M. Dent & Sons, London, p. 127, 1956 (1740).) According to Christine Korsgaard, Hume was right when he criticized the Rationalists for not having explained how reason is the normative force behind moral motivation. See her *The Sources of Normativity*, Cambridge University Press, Cambridge, pp. 10–12, 2009, along with her analysis of Realism on pp. 28–48.
 18. De Waal, ref. 14, pp. 20–21.
 19. De Waal, ref. 14, pp. 28–29.
 20. Francisco Ayala dissents, arguing morality is an evolutionary development from humans' extraordinary brain power. "Humans", he counters, "are ethical beings by their biological nature ... as a consequence of their eminent intellectual capacities ... are products of the evolutionary process, but they are distinctively human. Thus, I maintain that ethical behaviour is not causally related to the social behaviour of animals, including kin and reciprocal 'altruism'." (Ayala, F., Biology to Ethics: An evolutionist's view of human nature; in: Boniolo, G. and De Anna, G. (Eds.), *Evolutionary Ethics and Contemporary Biology*, Cambridge University Press, Cambridge, p. 148, 2006.)
 21. De Waal, ref. 14, p. 67. In case it is assumed that only the higher primates' actions are anthropomorphized, intention is oddly occasionally attributed to life-forms much further down the scale. For example, Yucca plants 'evaluate' and 'exercise' choice, and cleaner fish 'cheat the client'. For these and others, see Sachs, J.L., Mueller, U.G., Wilcox, T.P., and Bull, J.J., The evolution of cooperation, *The Quarterly Review of Biology* 79(2):135–160, Jun 2004. James Rachels has an interesting few pages on the inclusion of anthropomorphic language in popular animal accounts and its omission, or the use of scare quotes when doing so, in the academic journals. See his *Created From Animals: The moral implications of Darwinism*, Oxford University Press, Oxford, pp. 167–171, 1991.
 22. Singer, P., Ethics and intuitions, *J. Ethics* 9(3–4):331–352, Oct 2005; p. 336.
 23. Wright, R., The uses of anthropomorphism; in: De Waal, ref. 14, p. 88–89.
 24. Wright, ref. 23, p. 88.
 25. Wright, ref. 23, p. 85. Without doubt the greatest risible misuse of such language is found in Jane Goodall's speculation that chimps she observed, on their approach to a waterfall, displayed "awe [a] feeling generated by the mystery of water". What was the proof of such a claim? The chimps display a "slow rhythmic motion along the riverbed [and] pick up and throw great rocks and branches, and swung out on vines over the stream ... a magnificent 'dance'" (Goodhall, J., *Reason for Hope: A spiritual journey*, Thorsons, London, p. 188ff., 1999.) If that were not egregiously sloppy enough, Goodall, throwing all rationality out the window, postulates that this experience of awe, once language had emerged, may have been the origin of religion. Elsewhere, she writes of a caged lab chimp showing gratitude when she stopped to "talk to him". (Wright, ref. 23, p. 216.)
 26. Sanjida O'Connell proposes four levels of awareness: a "zero-order intentionality is where the animal is not aware of any subjective thoughts. First order intentionality states that the animal knows X, [e.g.] wants a banana, or has a representation of the banana. Second order intentionality states that the animal knows that another animal knows X, i.e. knows that the other animal wants a banana. The animal has a representation about a representation: it represents its belief about the second animal's desire (the representation of a banana) ... The capacity to have second order intentionality may be connected with self awareness, i.e. the animal knows that it knows. Third order intentionality would require the animal to know that a second animal knows that the first animal knows X. The ability to acquire third order intentionality and false belief is an acid test of theory of mind." (O'Connell, S., Empathy in chimpanzees: evidence for theory of mind? *Primates* 36(3):398, Jul 1995.) It's somewhat difficult to imagine a living creature possessing second-order intentionality without the capability of the third. My thought is that it appears the latter is superfluous.
 27. For an argument as to why animals have consciousness similar to ours, see Griffin, D.R., *The Question of Animal Awareness: Evolutionary continuity of mental experience*, The Rockefeller University Press, New York, 1976. Griffin argues that once you accept the evolutionary relationship between animal and man, it is "unparsimonious to assume a rigid dichotomy of interpretation which insists that mental experiences have some effect on the behaviour of one species of animal [i.e. man] but none at all on any other" (p. 74).
 28. Note the following as typical: "I begin by laying out some essential philosophical precepts underlying my argument, in particular the importance of *assuming* a phylogenetic continuum and with it evolutionary parsimony ... In order to be persuasive, any assessment of the ethological data relevant to animal morality has to *presuppose* such a phylogenetic continuum [emphases added]." (Putz, O., Moral apes, human uniqueness, and the image of God, *Zygon* 44(3):613–624, Sep 2009, p. 614.)
 29. If they didn't, or were unable to, explain away the data, they would be left with a paradox that leaves a creationist explanation as the only possible solution.
 30. See Povinelli, D.J. and Vonk, J., Chimpanzee minds: suspiciously human? *TRENDS in Cognitive Sciences* 7(4):157–160, Apr 2003. Others have also ruled out chimps possessing a human-like ToM, though conceding that they do possess some 'psychological' states. See the set of experiments in Tomasello, M., Call, J., and Hare, B., Chimpanzees understand psychological states—the question is which ones and to what extent, *TRENDS in Cognitive Sciences* 7(4):153–156, Apr 2003. Elsewhere it has been noted apes demonstrated no sign of understanding false beliefs in others, one measure of possessing a ToM. See Call, J. and Tomasello, M., A nonverbal false belief task: the performance of children and great apes, *Child Development* 70(2):381–395, March–April 1999.
 31. De Waal, ref. 14, p. 49.
 32. Hauser, M.D., *Moral Minds: How nature designed our universal sense of right and wrong*, HarperCollins, New York, pp. 387–389, 394–397, 2006.
 33. Kitcher, P., Ethics and evolution: how to get here from there; in: De Waal, ref. 14, p. 131. For a brief but relevant alternative interpretation of behavioural observations supporting the argument that apes have moral awareness, see Stingl, M., All the monkeys aren't in the zoo: evolutionary ethics and the possibility of moral knowledge, *Canadian J. Philosophy* 30(26):245–265, 2000; p. 252.
 34. Prinz, J.J., Is Morality Innate?; in: Sinnott-Armstrong, W. (Ed.), *Moral Psychology, vol. 1: The Evolution of Morality: Adaptations and innateness*, The MIT Press, Cambridge, MS, pp. 397–402, 2008. For valuable references of papers elaborating the ambiguity of interpreting animal distress as empathy, see Aronfreed, J., The socialization of altruistic and sympathetic behaviour: some theoretical and experimental analyses; in: Macaulay, J. and Berkowitz, L. (Eds.), *Altruism and Helping Behaviour: Social psychological studies of some antecedents and consequences*, Academic Press, New York, p. 110, 1970.
 35. Dennett, D.C., An evolutionary perspective on cognition: through a glass lightly, *Studies in History and Philosophy of Biological and Biomedical Sciences* 35(4):721–727, Dec 2004; p. 724. An early effort to attribute altruism in rats was attempted by George Rice and Priscilla Gainer. See their 'Altruism' in

- the albino rat, *J. Comparative and Physiological Psychology* 55(1):123–125, Feb 1962. Over a three-month period two sets of rats were daily exposed to an electric shock which could be terminated by pressing a bar. The experiment then added a suspended block which would be lowered once the bar was pressed. After this training and association was acquired, the rats were divided into two groups, one exposed to the same setting, the other, instead of a block, had in its place a suspended distressed rat which was squealing and wriggling. Compared with the controls, which had no suspended rat but a block, it was observed that the subjects with the suspended rat pressed the bar more frequently than the controls. The conclusion attributed altruism to these rats. However, a subsequent experiment pointed out a counterfactual explanation and proposed that the extra activity in the experiment, that is the wriggling rat, may act as a stimulant and thus increase the number of bar presses. This criticism led to an experiment exposing rat subjects to white noise and squeals. Contradicting the first experiment, the result demonstrated that white noise was more of an irritant than was a squealing rat. In conclusion, the authors noted “the squeals and the white noise must be regarded simply as two sources of auditory stimulation, the latter giving rise to more behavioural activity than the former.” (Lavery, J.J. and Foley, P.J., *Altruism or arousal in the rat?* *Science, New Series* 140(3563):172–173, 12 Apr 1963.)
36. Seyfarth, R.M. and Cheney, D.L., Empirical tests of reciprocity theory: problems in assessment, *Ethology and Sociobiology* 9(2–4):181–187, Jul 1988.
 37. Seyfarth and Cheney, ref. 36, p. 186.
 38. Korsgaard, C.M., Morality and the distinctiveness of human action; in: De Waal, ref. 14, pp. 105–106.
 39. Broom, D.M., *The Evolution of Morality and Religion*, Cambridge University Press, Cambridge, pp. 37, 68, 2003.
 40. Hauser, ref. 32, p. 313.
 41. Wilkinson, G.S., Reciprocal altruism in bats and other mammals, *Ethology and Sociobiology* 9(2–4):85–100, Jul 1988. Apart from this being almost entirely an experiment based on computer simulation, Wilkinson admits that undetected cheating remains a problem even if he tweaks thresholds to boundary conditions. He also lists several other problems which possibly undermine the validity of his conclusion. See esp. pp. 96–98.
 42. Hauser, ref. 32, p. 391. For Hauser’s brief, though quite detailed, analysis of these experiments, see pp. 383–392. It’s interesting to note a report of a symposium held in 1986 to commemorate the 15th anniversary of Trivers’ paper. While probably unaware of the special pleading, the report’s author relates: “Although there are still only a few satisfactory examples of the behaviour, most participants felt that reciprocity is more important and widespread than anyone has been able to show: standards of proof have been very high and the phenomenon is a difficult one to demonstrate.” (Packer, C., Whatever happened to reciprocal altruism?, *Trends in Ecology and Evolution* 1(6):142–143, Dec 1986; p. 143.) And yet, it is still serially promoted as one path through which morality came into existence.
 43. For a brief but detailed analysis of her work and criticisms, see Sussman, R.W., Cheverud, J.M. and Bartlett, T.Q., Infant killing as an evolutionary strategy: reality or myth? *Evolutionary Anthropology: Issues, News and Reviews* 3(5):149–151, 1994; and Hardy, S.B., Janson, C., and van Schak, C., Infanticide: let’s not throw out the baby with the bath water, *Evolutionary Anthropology: Issues, News and Reviews* 3(5):151–154, 1994. Human psychopathy has also been compared with ‘sneaker’ salmon which stealthily fertilize female eggs before the dominant male can. See Jalava *et al.*, ref. 4, p. 73.
 44. For a critical review of the experimental use of animals to infer human behaviour and medical conditions, see chapter 3, ‘What’s Wrong with Their Mice?’ in Rose, N. and Abi-Rached, J.M., *Neuro: The new brain sciences and the management of the mind*, Princeton University Press, Princeton, NJ, 2013.
 45. Alternatively, and less critically, in an unfallen world, higher-order animals may very well have been capable of higher affective behaviours, such as altruism, and thus in this post-Fall environment, faint traces may still be discernible.
 46. Dawkins, R., *The God Delusion*, Houghton Mifflin, New York, p. 301, 2006.
 47. Singer, P., Animal liberation; in: Rachels, J. (Ed.), *Moral Problems: A collection of philosophical problems*, Harper & Row, New York, p. 98, 1979. Singer makes it quite clear he’s averse to the idea of poisoning these little creatures, opting instead for sterilization procedures. Such action may cleanse a guilt-ridden conscience but I wonder if it occurred to him that sterilization, in the end, effects the same end as rat bait; namely, the (quite possibly total) elimination of rodents. Elsewhere, in an online debate with Richard A. Posner, a judge of the U.S. Court of Appeals for the 7th Circuit and a senior lecturer at the University of Chicago Law School, Singer presented an argument for animal rights based on equal consideration of interest and abandoning “ancient religious teachings”. He writes, “The only acceptable limit to our moral concern is the point at which there is no awareness of pain or pleasure, and no preferences of any kind. That is why pigs count, but lettuces don’t. Pigs can feel pain and pleasure. Lettuces can’t.” (Singer, P., Animal rights, *Slate*, 12 Jun 2001. [slate.com/news-and-politics/2001/06/animal-rights-2.html](https://www.slate.com/news-and-politics/2001/06/animal-rights-2.html). For Posner’s response, see [slate.com/news-and-politics/2001/06/animal-rights-3.html](https://www.slate.com/news-and-politics/2001/06/animal-rights-3.html), accessed 8 Sep 2021.) I consider this, among other criticisms, arbitrary; for it possesses no more warrant than if I were to articulate, “the only acceptable limit to our moral concern is the point at which there is no awareness of right or wrong, and no moral preferences of any kind. That is why humans count, but pigs don’t. Humans can understand right and wrong. Pigs can’t.”
 48. Rachels, ref. 21, p. 77.
 49. O’Hear, A., *Beyond Evolution: Human nature and the limits of evolutionary explanation*, Oxford University Press, Oxford, p. 144, 1999.
 50. O’Hear, ref. 49, p. 144.

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The origin of L-amino acid enantiomeric excess: part 2—by preferential photosynthesis using circularly polarized light?

Royal Truman

In some recent experiments, low temperature samples mimicking interstellar ice were irradiated with circularly polarized light (CPL). A few amino acids (AAs) were produced having a small enantiomeric excess (ee), suggesting a natural source of L-AAs to produce proteins. However, the excess in D and L were in the opposite direction when using pure r-CPL vs l-CPL. Even neglecting that UV CPL has never been found in nature, further speculating that only *one* polarity from some hypothetical sources might have existed instead of a mixture is difficult to justify. Furthermore, the authors experimented with an optimal, very narrow wavelength, since different wavelength ranges alternated between excess of D and L enantiomers. The effects over a broad absorption spectrum would have tended to cancel. There is also reason to suspect measurement errors. Experiments with non-polarized light were expected to produce racemic AAs since the samples did not contain any chiral molecules, but unexpectedly an ee was measured. Therefore, these experiments do not provide a credible source of excess L-AAs. The hypothetical ee would have been negligible and delivered to a putative hot prebiotic earth where L→D inversion would have occurred in addition to mixing with existing racemic AAs.

Several mechanisms have been proposed to explain the origin of homochirality, the use of only one enantiomer in constructing proteins, RNA and DNA.¹ The best-known theory for L-amino acids (L-AAs) involves asymmetric photochemistry of AAs present in space by UV right-circularly polarized light (r-CPL), discussed in part 1 of this series.² CPL is an electromagnetic wave, the electric field vector of which traces a spiral in the direction of propagation, as shown in figure 1.

Rubenstein *et al.* suggested, in 1983, that regions on opposite sides of the plane of predominant polarization would be exposed to light of opposite helicity, although overall symmetry would be preserved.³ Key papers followed up on this suggestion.^{4–7} Enantioenriched photoproducts were proposed to have been delivered to Earth by comets and meteorites.^{8,9}

Approximately 1% enantiomeric excess (ee) has been claimed for some AAs in optimized synchrotron experiments *after photo-destroying 99.99% to 99.999% of racemic D- and L-AA mixtures*. A specific wavelength was selected to optimize the miniscule effect.¹⁰ However, different wavelengths selectively destroy D- or L-AAs, tending to annul any net effect.² In addition, a specific AA, leucine (Leu), was emphasized in these experiments, known to have an abnormally large difference in molecular absorption coefficient (ϵ) when using UV CPL.²

Experiments producing racemic amino acids

Earth's early atmosphere was supposedly non-reducing, with CO₂ being the main source of carbon.¹¹ But experiments using high energy sources (acting on gas mixtures thought to reflect the putative ancient Earth atmosphere) to generate reactive fragments have produced, at most, trace amounts of only the simplest AAs.¹¹ Therefore, a more suitable chemical environment had to be found.

Muñoz and colleagues performed some experiments in 2002, showing that AAs form at very low temperatures using UV light.¹² An ice mixture containing H₂O, CH₃OH, NH₃, CO, and CO₂ in 2:1:1:1:1 molar proportion was placed in a high-vacuum chamber at 12 K and irradiated with UV light having energy 7.3–10.5 eV, mostly around 10.2 eV, which corresponds to a wavelength of $\lambda = 121.6$ nm.¹² After warming to room temperature, the small amount of residue formed was hydrolyzed with 6 N HCL to extract AAs from larger materials such as peptides. 16 AAs were identified, 6 of which are found in proteins. Glycine was by far the major product. It is important to recall, though, that glycine and other AAs have so far not been detected in the interstellar medium.¹²

Similar results were obtained when the carbon-containing molecules were isotopically labelled (i.e. using H₂O, ¹³CH₃OH, NH₃, ¹³CO, and ¹³CO₂) to determine from the products if terrestrial contamination was occurring. No evidence for contamination was found but now valine and proline were not detected.¹² This illustrates the technical

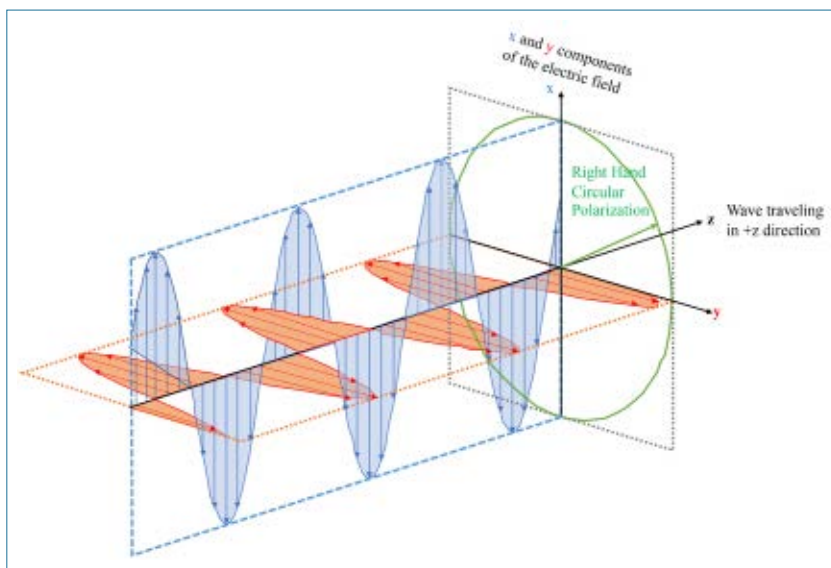


Figure 1. Right Hand Circular Polarization. Uniform plane wave travelling in the +z direction. The x and y components of the electric field are shown in blue and red, respectively. The total electric field, z , is shown in green. Based on a video by the ElectroScience Laboratory in the Department of Electrical and Computer Engineering at the Ohio State University; [youtube.com/watch?v=jY9hnDzA6Ps](https://www.youtube.com/watch?v=jY9hnDzA6Ps)

difficulties of these kinds of experiments and the caution needed when reading the papers.

In studies like these and those which report the proportion of D- and L-AA enantiomers from meteorites statistical analysis reveals something remarkable. In a significant majority of cases when the enantiomeric proportions are within experimental error, more L is reported. The difference is often less than 1% and believed to be within random experimental error, but why is the error not randomly distributed? This appears to be an example of bias in data cleanup and selection of which repeated measurements were included in averages and how the results were described.¹³

Concerning the principle of researcher bias, we read in this study that

“As expected for photosynthesis using *unpolarized light*, the amino acids produced *appeared to be racemic*, with enantiomeric excesses *fluctuating within experimental errors* [emphases added].”¹²

And what should be considered experimental error? The L/D ratio for serine reported was 3.86 / 3.29 depending on the helicity of the CPL. This corresponds to an enantiomeric excess of $100 \times (3.86 - 3.29) / (3.86 + 3.29) \approx 8\%$. For aspartic acid, the only case in which the D enantiomer predominated, L/D was 1.07 / 1.14, which corresponds to $ee_L = -3.2\%$. Empirical calibration errors could creep into these kinds of studies, since the AAs are usually chemically derivatized to facilitate GC (gas chromatography) or LC (liquid chromatography) analysis, and the resulting labelled diastereomers have different relative spectral absorptivity. In the majority of cases, corrections are necessary, creating opportunities for errors.¹⁴

When there is a consensus that a racemic mixture must result, then even 8% ee_L was not further commented on, but the opposite also occurs routinely. To illustrate, the first studies on the Murchison Meteorite reported that the biogenic AAs were racemic and this was used as evidence for lack of terrestrial contamination.^{15–17} These researchers had selected the best fragments available and presumably believed L-AAs could have arisen on earth for origin-of-life purposes. Later, other evolutionists wished to show that AAs having an excess of L-form may have been the source of original homochirality and reported their results from experiments based on less pristine samples, when contamination was more likely to have accumulated. They now claimed small excesses were found, far under 8% ee , results the original researchers strongly claimed were experiment

artefacts.¹⁸ Scientists must be very wary about claims which are very close to being within experimental error where not all the repeated tests are reported and the experiments are technically difficult to reproduce, whereby the results support a favoured but controversial view. Confirmation bias can occur unconsciously or deliberately.

It is assumed that tiny silicate and carbon-based interstellar dust grains may have provided an environment to form very simple molecules which served as building blocks for biologically relevant more complex molecules. Accretion from the gas-phase collisions, and chemical reactions on the surface would coat the grain with refractory carbonaceous matter. These grains would eventually contain frozen H_2O , CO_2 , CO , NH_3 , as well as small amounts of CH_3OH , CH_4 , H_2O , and $HCOOH$.¹⁹

In another experiment, also published in 2002, Bernstein *et al.* created ice films at 15 K consisting primarily of H_2O mixed with 0.5–5% NH_3 , 5–10% CH_3OH , and 0.5–5% HCN , relative to H_2O .¹⁴ UV irradiation used light nearly evenly divided between the Lyman α -line (121.6 nm) and a ~ 20 nm wide source centered at 160 nm. Each sample was photolyzed with a photon flux corresponding to ~ 500 years at the edge of a dense cloud.¹⁴ After deposition and photolysis, the ices were warmed at ~ 2 K/min under dynamic vacuum at $\sim 10^{-8}$ torr to room temperature, leaving behind an organic residue, which was hydrolyzed with concentrated HCl to produce free AAs.¹⁴ Three AAs were identified, serine, glycine, and alanine. The chiral ones (serine and alanine) were found to be racemic within the integration error ($100.1 \pm 1.6\%$) using GC-MS.

Experiments producing an enantiomeric excess

Meierhenrich reported in 2010 that enantiomers in aqueous solution could absorb slightly differently at a given wavelength.²⁰ To obtain a small L-excess, a researcher must carefully expose a racemic mixture of an AA to CP UV light of the ‘correct’ wavelength(s). Of course, the same L-AA will absorb less strongly than its D-AA counterpart at another wavelength, counteracting the desired outcome.

The first cosmic ice simulation experiments that produced an AA (alanine) with enantiomeric excess was reported in 2011 by a team led by Nahon and d’Hendecourt.²¹ They used a gas mixture of $\text{H}_2\text{O}^{13}\text{CH}_3\text{OH}:\text{NH}_3$ (2:1:1) at 80 K irradiated with an energy of 6.64 eV (186.7 nm) for ~36 hr in a high vacuum chamber. The high temperature (80 K) was used instead of the observed temperatures for interstellar ices (10–20 K) to enhance formation of photoproducts within the ices. After warming to room temperature at a rate of 1 K/min the samples were irradiated at room temperature for another 10 hrs. The samples were then hydrolyzed with 6 M HCl at 110°C for 24 hrs to extract free AAs.²¹

This led to an ee_L of -1.34% ($\pm 0.40\%$, 3σ) alanine using r-CPL vs. $+0.71\%$ ($\pm 0.30\%$, 3σ) when using l-CPL. An approximately twice as intense UV beam was used in the case of r-CPL, which might explain the difference in ee (i.e. more photolysis would have occurred). No isovaline (which has the highest ee reported from meteorite carbonaceous chondrites) was identified. The major product was glycine, 14 times more abundant than the second most abundant AA, alanine.²¹

Nahon and colleagues from the SOLEIL Synchrotron in France reported other experiments in 2013. They monitored the spectra of gaseous neutral alanine molecules photoionized with CPL having a fixed photon energy of $h\nu = 10.2$ eV (121.6 nm). This energy can only eject photoelectrons from the highest occupied molecular orbital of neutral alanine.^{21,22} From the spectral data, the researchers estimated that at interstellar temperatures ranging from 10 to 200 K about 0.5 – 2% of the alanine molecules would survive ionization at 10.2 eV. If some alanine had survived this irradiation, they thought that a maximum of 4% ee could have been attained in the limit of pure CPL, based on a mathematical model.²¹ Their conceptual scenario assumed that a racemic mixture of gas-phase alanine would be embedded into a CPL field with a given and constant helicity over a large region of space.

Clearly these kinds of studies are artefacts from carefully designed laboratory experiments. The concentration of racemic alanine would have been infinitesimally low, of which almost all would have to be destroyed through irradiation to produce a very small ee , using just the right CPL wavelength and unmixed helicity. To put things in perspective, so far, the only AA claimed to have been detected in the interstellar medium is glycine, which is not

even chiral. Even this observation remains unlikely since some spectroscopic lines which should have been present were not found.²³

The only evidence from astronomy for circular polarization involves near-infrared wavelengths, thought to arise from the scattering of stellar radiation from aligned dust grains.^{2,24} This part of the electromagnetic spectrum has no relevance to AA photo-destruction, because the photon energy is too low. Destruction can be caused by higher energy UV (<300 nm) absorbed by the carboxylate chromophore attached to the α -carbon.

As already emphasized, despite intense effort, no astronomical UV CPL has been found. In part 1 of this series, it was shown that the small enantiomeric excess increases and reverses depended on the UV wavelength, and there is no reason why only r-CPL would have existed.² The hypothetical scenario would have produced $<1\%$ ee_L after photo-destroying over 99.999% of the racemic AA. Slow, extraterrestrial influxes of this concentration and purity render naturalist origin-of-life models even less plausible, especially since the miniscule ees would have racemized on Earth in water during long geological times.

Irradiation of CO, NH_3 , and H_2O at very high energy

In another study a gaseous concentrated mixture of carbon monoxide, ammonia, and water was irradiated with high-energy 3.0 MeV protons from a van de Graaff accelerator.²⁵ A complex mixture of organic materials was obtained having molecular weight ranging from several hundred up to 3,000 Daltons. This mixture was then irradiated with UV r-CPL and l-CPL having wavelengths >200 nm.

After UV-CPL irradiation, the material was hydrolyzed with 6 M HCl at 110°C for 24 h to extract free AAs. Seven biogenic AAs were identified, where glycine predominated. No leucine was found. The r-CPL is claimed to have produced alanine having $ee_D = 0.44\%$ and using l-CPL to an $ee_L = 0.65\%$.²⁵

These results are consistent with other simulation experiments using proton irradiation, UV irradiation and gamma-ray irradiation under simulated interstellar environments. These conditions, however, were not shown to form free AA precursors which might lead to AAs.²⁵ These studies also showed that the chemically bound AA analogs formed were photochemically much more resistant to destruction by gamma rays and UV irradiation than free AA analogs.²⁵

Photosynthetic mechanisms?

Producing an enantiomeric excess of L-AA is almost always assumed to require selective photo-destruction of 99.99% or more of the AA using CPL. Perhaps more efficient

mechanisms exist to directly synthesize AAs aided by CPL. However, as Meierhenrich *et al.* pointed out in a 2018 review article, “Investigations on the absolute asymmetric synthesis of amino acids are scarce.”²⁶

Photosynthesis of AA using unpolarized UV light

To find potential paths able to produce an extraterrestrial enantiomer excess, it is helpful to identify photochemical mechanisms which produce AAs. In 2016 Oba *et al.* examined a mixture of CH₂DOH, H₂O, CO, and NH₃ in a ratio of 2:5:2:2, irradiated at 115–170 nm for 20 hrs at 10 K.²⁷ The use of deuterated methanol (CH₂DOH) helped establish what radical species are involved in forming which products.²⁷ At this wavelength photodissociation of methanol is known to form specific radicals, as shown in figure 2A.^{28,29} In addition, unimolecular hydrogen molecule elimination (UHME) will also occur, as shown in figure 2B.^{28,30}

Glycine, α -alanine, β -alanine, sarcosine, and serine, and various isotopologues having a deuterium (D) atom bound to carbon atoms, were found in organic residues formed after warming up to room temperature. For simplicity, the deuterated products are not shown in figure 2. The abundances of AAs obtained increased by a factor of more than five after hydrolyzing the organic residues.

The researchers assumed that these five AAs were produced by reactions of small radicals during warming of the irradiated ice and that most AAs formed were incorporated into macromolecules via relatively weak bonds such as peptide bonds.²⁷

The kinds of radicals formed and their proportion will depend on the compounds available. It seems highly unlikely that CPL of a single handedness would produce radicals which lead to predominantly D- or L-AAs. This is especially true when considering that slow warming in space over thousands of years to permit radicals to combine into stable bonds would tend to produce racemic products. Nevertheless, experiments have been conducted to determine if an *ee* could be obtained.

Photosynthesis of AA using CPL UV light

Pioneering work to determine whether an *ee*_L could be produced through photochemical synthesis (instead of selective photochemical destruction) was reported by Nuevo *et al.* in 2006.^{31,32} The authors prepared interstellar ice analogs by depositing

equimolar H₂O, ¹³CH₃OH and NH₃ onto a cooled substrate at 80 K and irradiating either with r- or l-CPL at 167 nm, see figure 3. The authors reported an *ee* <1% for α -Ala and 2,3-diaminopropanoic acid.

In a key 2014 study conducted at the SOLEIL synchrotron facility in France, Modica *et al.* irradiated water, methanol, and ammonia ice in a ratio of ~2:1:1 H₂O, ¹³CH₃OH and NH₃ with an intense UV beam.³³ Methanol was labelled with ¹³C to help distinguish between true products and terrestrial contamination during the experiments.³³

The experiments were carried out at 77 K in a high-vacuum chamber at a pressure <10⁻⁷ mbar, linked to a Fourier transform infrared spectrometer. Separate experiments used different UV wavelengths, 188 nm (6.6 eV) and 122 nm (10.2 eV). In some experiments, the original ices were irradiated, in others, organic residues resulted. In the third type of experiment, both ice and organic residues were irradiated.³³

At the end of the irradiation, the ice samples were slowly warmed at 1 K/min to room temperature (to allow diffusion of free radicals and subsequent recombination). During this process, the volatiles (~99.9% of the products formed), sublimated and were removed by the pumping system. Solid residue was obtained at room temperature. Hydrolysis was performed on the residue material using 6 M HCl for 24 hr at 110°C to liberate free AAs which were analyzed with multidimensional GC.³³

The researchers identified 16 distinct AAs (24 counting individual enantiomers), see table 1.

The measured *ee*_L values for alanine as a function of the photon energy (i.e. wavelength), the stage at which the

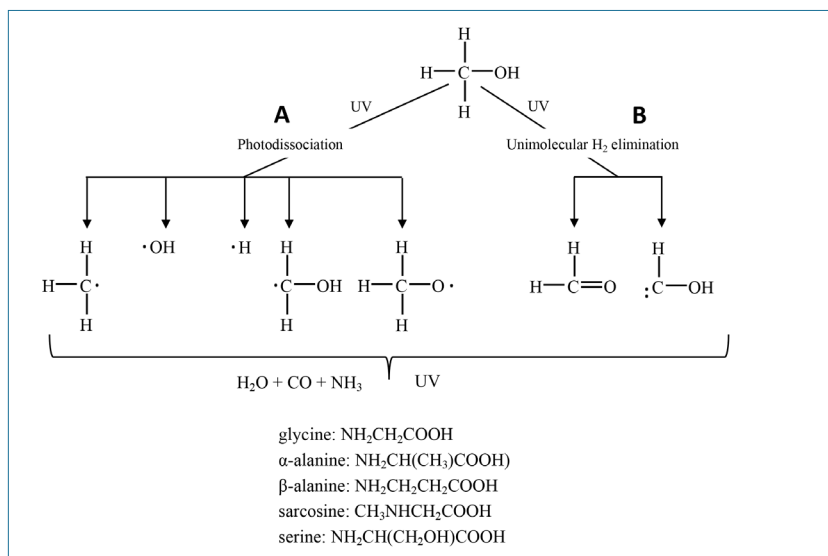


Figure 2. Low-temperature products resulting from UV irradiation of methanol in the presence of water, carbon monoxide, and ammonium. **A.** photodissociation radicals. **B.** unimolecular hydrogen molecule elimination.²⁷

samples were irradiated by CPL, and the helicity of CPL used are shown in table 2. The experiments were conducted at different times and under differing experimental conditions, such as photon flux per deposited molecules and concentrations of the extracted samples; therefore, comparing the absolute *ee* values is difficult.

Remarkably, the results from irradiation of the ice might indicate that the reactions of the radicals are affected by the helicity of the CPL. This would imply that the *ee_L* of alanine is not only caused by selective photolysis. In any event, the possible excess would be very small. Recall that in experiments above using unpolarized light, *ee* values of 3% and 8% were stated to be racemic within experimental error.

Of the products formed, the enantiomeric excess of five were measured: α -alanine, 2,3-diaminopropionic acid, 2-aminobutyric acid, valine, and norvaline, with *ee_L* values ranging from $-0.20\% \pm 0.14\%$ to $-2.06\% \pm 0.34\%$, as shown in table 3. The statistical uncertainties reported were based on multiple gas chromatographic injections for each sample (up to 10), and not repetition of the entire experimental protocol.³³ We are not informed why the number of repetitions ranged from 3 to 7, since repeating GC runs is very easy.

As discussed in part 1,^{2,9} due to the wavelength dependence of asymmetric photochemical reactions, the sign of the induced *ee_L* depended, for the five AAs examined, on the helicity and the energy of CPL.

It is noteworthy that the *ee_L*s were induced in both the ice-only and residue-only samples irradiated by CPL. In the case of the irradiation of the water/methanol/ammonia ices, a two-step reaction may be occurring:

- Step 1. Initially the CPL forms ions, radicals, and/or small molecules which possess a chiral centre (these could also be induced by ordinary unpolarized light).
- Step 2. Asymmetric photochemical processes then occur on the chiral intermediates, preferentially producing one of the enantiomers. For example, a precursor enantiomer could be selectively asymmetrically photolyzed.³³ The recombination reactions which occur during the warming up phase of the ices without any further irradiation appear to retain an impact of the effect caused by the chiral CPL field.³³

In the case of irradiation of the residue using CPL of only one helicity, racemic mixtures of chiral molecules were present. Presumably destructive photolysis of one enantiomer

occurred, as described in part 1.^{2,33} That mechanism *requires photoreduction of >99.99% of racemic AAs* to produce an enantiomeric excess of about 1% of one of the enantiomers.

The five AAs in table 3, when irradiated with r-CPL, always led to an excess of L-enantiomer, and l-CPL to an excess of the opposite enantiomer. Notably, the unpolarized light should have always produced racemic mixtures but did not. In fact, the average of six or seven measurement repetitions produced *ee_L* values ranging from -0.05% to $+0.67\%$, as shown in the right-most column of table 3. In two of the five AAs, irradiation with UPL led to absolute *ee_L* values of over 0.6%.

Unexpectedly, for α -alanine a larger absolute *ee* was reported when irradiated with UPL than l-CPL (0.46 vs -0.34). The same unexpected behaviour was also obtained for 2,3-diaminopropionic acid (0.67 vs -0.20). Therefore, *ee_L* results between $\pm 1\%$ might be spurious, representing about half of the results when applying r-CPL and l-CPL in table 3. This suggests that identifying real *ee*s, even under ideal experimental conditions, is quite difficult.

Furthermore, the authors pointed out that the presence of ¹²C fragments in the mass spectra demonstrated terrestrial contamination especially in the case of alanine.³³ This is the second most abundant AA found in human proteins, after leucine, raising the possibility of accidental contamination during experimental handling. This contamination occurred despite great care to prevent it. This illustrates how easy it is to also pick up terrestrial contamination of L-AAs when studying the composition of meteorites, in which sometimes *ee_L* values of $\sim 1\%$ have been claimed.

Astronomical significance

The best candidates for CPL sources have been proposed to be reflection nebulae in star-forming regions associated with a dominant high-mass young stellar object.³³ High levels of CPL have been observed in the near-IR (NIR) spectra in reflection nebulae such as OMC-1, at levels of -5 to $+17\%$ ^{5,34–36} and more recently in NGC 6334, at levels of 22% .^{37,38} To date, however, no chiral molecule has been identified in the interstellar medium.³³

Modica *et al.* proposed an astrophysical scenario in which the solar system was formed in a high-mass star-forming region where icy grains in the outer solar nebula might have been exposed to irradiation of a single helicity,

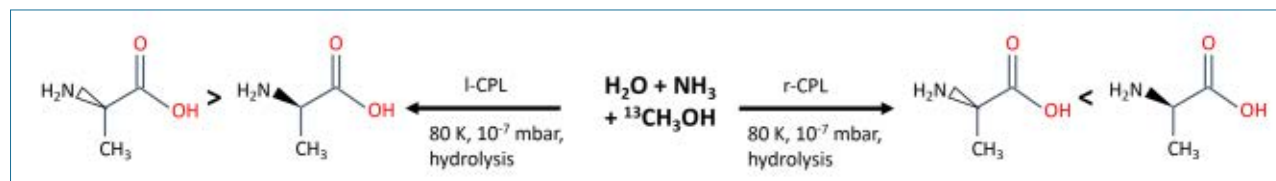


Figure 3. A mixture of $\text{H}_2\text{O}:\text{H}_2\text{O}^{13}\text{CH}_3\text{OH}:\text{NH}_3 = 1:1:1$ irradiated with CPL led to no or an insignificant amount of amino acid enantiomer excess^{31,32}

Table 1. Biogenic and non-biological amino acids identified in CPL-irradiated organic residues³³

Nr.	Nr. Cs	Compound	Nr.	Nr. Cs	Compound
1	2	glycine	11	4	N-ethylglycine
2	3	sarcosine	12	4	D-2-aminobutyric acid
3	3	N-methyl-D,L-alanine	13	4	L-2-aminobutyric acid
4	3	α -D-alanine	14	4	D,L-3-aminoisobutyric acid
5	3	α -L-alanine	15	4	D-3-aminobutyric acid
6	3	β -alanine	16	4	L-3-aminobutyric acid
7	3	D-serine	17	4	4-aminobutyric acid
8	3	L-serine	18	4	D-aspartic acid
9	3	D-2,3-diaminopropionic acid	19	4	L-aspartic acid
10	3	L-2,3-diaminopropionic acid	20	5	D,L-proline
			21	5	D-valine
			22	5	L-valine
			23	5	D-norvaline
			24	5	L-norvaline

inducing a stereo-specific photochemistry.³³ The grains on which molecules were photosynthesized could have accreted on comets and asteroids. At that point the molecules may have been shielded from further UV exposure until their delivery to the early Earth during or just after the late heavy bombardment.³³

Chondrites are stony meteorites which contain small mineral granules called chondrules. Carbonaceous chondrites comprise about 3% of all meteorites collected and are of interest because they contain a high proportion of carbon (up to 3%). They are subdivided into six groups based on their chemistry and other criteria (CI, CM, CV, CO, CR, and CK). If photosynthetic routes had formed large ee_L s for AAs in putative presolar ices, this would be apparent across the various meteorite classes. However, the relative proportions of D- and L-enantiomer for α -AAs do not support this. The non-proteogenic isovaline (which lacks an α -hydrogen and is therefore very difficult to racemize) is an exception with more L-isovaline enantiomer being reported for the small minority of meteorites of class CR. This excess was not even found in meteorite classes CR2 and CR3, though.³⁹

An important observation is that the relative absorptions of UV CD spectra of the α -methylated AAs L-isovaline and L- α -methyl valine are in the opposite direction to those of protein relevant enantiomers of α -H AAs.⁴³ Therefore, their putative presence would predict an excess of the ‘wrong’ D- α -hydrogen AAs being delivered to Earth.⁴⁰

Conclusions for origin-of-life purposes

In experiments like those discussed above, high energy sources were used to produce charged chemical fragments or radicals, which then combined to produce various molecules, including trace quantities of AAs. High energy sources such as UV light, protons, intense shock, or electric discharge as used in the Miller-Urey experiments can of course do this.⁴¹ In some experiments, the energy source was CPL and in others, r-CPL or l-CPL was applied after the fragments or molecules had formed.

Most authors claim that their experimental conditions reflect some degree of plausibility to natural conditions. We see instead that in all cases an intended outcome determined how the experiments were expertly set up. To produce AAs, reactive carbon-, nitrogen-, and hydrogen-containing fragments were produced

in very high concentrations, thanks to the near ideal relative stoichiometries at the same location; high concentration of starting materials; intense energy source; and use of a closed container. Forming key -CO, -NH and -CH fragments was inevitable under the expertly guided conditions, and the intended chemical reactions were inevitable upon careful warming up since the reactive fragments formed were not allowed to simply diffuse into free space. Typical heating rates of icy mantles under astrophysical conditions are on the order of only 1 K per century. This influences the mobility of reactants as they desorb in the ices.¹⁹ However, laboratory studies on the photostability of AAs have demonstrated their limited survival when exposed to interstellar UV irradiation over a wide range of wavelengths near 200 nm and cosmic rays.⁴²⁻⁴⁵ Only a small proportion might be embedded in chemically bound form in the interior of comets and asteroids and thus shielded from the destructive radiation.¹⁹

The importance of producing large numbers of concentrated reactive fragments by experimental design is demonstrated by the considerably greater variety of products generated upon producing greater amounts of residue.³³

Obtaining an enantiomeric excess then required further expert guidance. Whether a positive or negative ee_L resulted depended on the wavelength of irradiating CPL. In outer space this effect would cancel out almost entirely since natural sources of CPL would be spectrally broadband.³³ Recalling that an excess of r-CPL or l-CPL has never been

found by astronomers, we see, in addition, that the experiments used only one or the other, and at a wavelength already known to be absorbed more strongly by one AA enantiomer.

One might argue that, by chance, the UV wavelength distribution might have been such that photolysis destroyed more of the D-enantiomer. For example, aliphatic AAs have a strong absorption UV band centred at about 210 nm. However, as Belgian scientists Cerf and Jorissen noted, other biogenic AAs having additional functional groups show the opposite effect in the same region.⁶ An example is tryptophan, which has a strong circular dichroism (CD) band centred at about 195 nm, with an opposite sign to the carboxyl 210 nm band. Proline is another example, with a strong CD band of opposite sign around 193 nm in a neutral solution.⁶ Therefore, an ee_L for all the relevant AAs would not have been produced.

CD spectra for l-CPL and r-CPL are needed to determine how severe this problem is, and these must be measured for neutral AAs and not in aqueous solutions, to reflect conditions in space. Other AAs exhibit complex CD absorption due to the presence of other chromophores in their side chain such as an aromatic ring for phenylalanine, tyrosine, and tryptophan and a sulfur-containing group for cysteine and methionine.⁶

Having set up experiments which do not reflect any known natural astronomical conditions, the researchers were able to obtain, at best, an $ee_L \sim 1\%$, present in vanishingly small concentrations. Recall that about 99.99% photo-destruction was necessary, but of course 100% must not occur!

Although no UV CPL from astronomical sources has ever been found, Bailey *et al.* gave some thought about how high an ee_L could be if more L-AAs were produced under optimal conditions. They pointed out that the global ee on an ancient post-bombardment Earth would be less than that of the original source material due to racemization (with full racemization estimated at 10^6 years at 0°C to 10^3 years at 50°C).⁴⁶ They also noted correctly that dilution with terrestrially produced racemic AAs would also have reduced the excess. They then proposed that the global ee would be in the range of 5×10^{-3} to 10^{-7} . The higher value assumes 50% of the AAs were of extraterrestrial origin, having 10% ee and a racemization time scale of 10^6 years. The lower estimate is based on a 1% extraterrestrial source of AAs having 10% ee and a 10^3 -year racemization timescale on average for each

Table 2. Measured enantiomeric excesses of α -alanine³³

Energy (eV)	CPL ^a Irradiation Stage	r-CPL ee_L (%) ^b	l-CPL ee_L (%)	LPL ^c / UPL ^d ee_L (%)
6.6	ice	-0.51 ± 0.21	-	0.30 ± 0.26
6.6	ice + residue	-1.34 ± 0.40	0.71 ± 0.30	-0.04 ± 0.42
6.6	residue	-0.74 ± 0.34	-	-
10.2	ice	1.3 ± 0.45	-0.76 ± 0.29	0.00 ± 0.96
10.2	residue (third experiments)	0.72 ± 0.26	-0.82 ± 0.33	
10.2	residue (fourth experiments)	1.04 ± 0.39	-0.34 ± 0.24	0.46 ± 0.36

^a CPL = Circularly polarized light

^b $ee_L = (A_L - A_D)/(A_L + A_D)$, where A is the GC peak area

^c LPL = Linearly polarized light

^d Unpolarized light using a microwave-stimulated hydrogen flow discharge lamp at 121 nm

^e \pm standard deviation at 3σ over n up to 10 GC injections

kind of AA.⁴⁶ This is not plausible. An estimate of $ee_L \approx 10^{-7}$ for biogenic AAs (even though already fatal for the claimed basis of AA ee) would still be far too high. Let us see why.

Sometime after a putative late heavy bombardment, AAs would have become thermally stable as the earth cooled. For a few million years the oceans would have remained extremely hot and accumulated perfectly racemized AAs. In fact, complete racemization at around the boiling temperature of water would have occurred in a matter of only days.³ Evolutionists believe AAs were delivered slowly via cometary and asteroid impacts or perhaps when the earth traversed molecular clouds.^{6,33} Most of the AAs would have been in chemically bound state, but under the still very high temperature conditions hydrolyzed to form free AA, which then racemized.

After eventually cooling to about 50°C (where the authors assumed a racemization time of 10^3 years) it is inconceivable that extraterrestrial AA now arriving would constitute 1% of the total amount present (since c. 100% racemized AA would have accumulated from all sources over millions of years). The freshly arriving AAs would need to survive the heat generated during passage through the atmosphere and the impact with the earth. Most of the new AAs arriving would be chemically bound, and not land in an environment of 6 N HCl at over 100°C (the conditions to free the AAs in a laboratory). Any conditions able to free these bound AAs faster, such as higher temperatures or basic catalysts, would have also accelerated the rate of racemization.⁴⁷

Furthermore, photochemical reactions producing AAs in the presence of UV CPL would be far less frequent than in

Table 3. Enantiomeric excesses in five amino acids after irradiation at 121.6 nm (10.2 eV)³³

Amino acid	r-CPL ^a <i>ee_L</i> (%) ^b (<i>n</i>) ^c	l-CPL <i>ee_L</i> (%) (<i>n</i>)	UPL ^d <i>ee_L</i> (%) (<i>n</i>)
α-alanine	1.04 ± 0.39 ^e (6)	−0.34 ± 0.24 (6)	0.46 ± 0.36 (7)
2,3-diaminopropionic acid	2.06 ± 0.34 (5)	−0.20 ± 0.14 (4)	0.67 ± 0.36 (7)
2-aminobutyric acid	1.28 ± 0.22 (5)	−2.54 ± 0.28 (6)	−0.61 ± 0.43 (6)
valine	1.08 (1)	−1.82 ± 0.30 (6)	−0.30 ± 0.44 (6)
norvaline	0.90 ± 0.33 (3)	−0.78 ± 0.39 (6)	−0.05 ± 0.34 (7)

^a CPL = Circularly polarized light^b $ee_L = (A_L - A_D)/(A_L + A_D)$, where *A* is the gas chromatogram (GC) peak area^c *n* = number of replicate GC analyses^d UPL = Unpolarized light, using a microwave-stimulated hydrogen flow discharge lamp at 121 nm^e ± standard deviation at 3σ over *n* GC injections

the presence of unpolarized UV light, the only kind of UV radiation found in space to date. Therefore, an extraterrestrial influx having 10% *ee* on average from all sources for all biogenic AAs is not realistic. One does not observe all AAs displaying such high *ees* across all meteorite classes, not even for leucine, the exceptional case which might be able to produce an *ee*. Most of the AAs of extraterrestrial origin show no *ee*, and the exceptions are on the order of 1–2% *ee*, widely assumed to be caused by terrestrial contamination.

Note that as time passed, the total volume of racemized AA on an early earth would have steadily increased, leading to ever greater dilution of newly arriving AAs having a putative *ee_L*. Under plausible evolutionary prebiotic scenarios an *ee_L* <<10^{−7} would have to be assumed for all time periods.

Water is necessary to dissolve AAs and peptides, and indeed most of the AAs arriving would have landed in water or been flushed into an ocean over time. However, peptide elongation in water is always slower than racemization, so production of large homochiral peptides would not have occurred.⁴⁸ As the German evolutionist chemist Dr Günter Wächtershäuser pointed out (translated):

“The primordial soup theory has faced devastating criticism for being illogical, inconsistent with thermodynamics, chemically and geochemically implausible, inconsistent with biology and biochemistry, and experimentally disproved.”⁴⁹

This source of *ee_L*, based on hypothetical and idealized reaction conditions, makes no useful contribution to a naturalist explanation for the origin of homochiral biopolymers. In fact, it appears to be terminally damaging to the speculations that are still popularized, without substantiation, in the literature. Evolutionists are left to make do as best possible, however, and further speculate that miniscule excesses of L-enantiomers once present may have separated from the D-enantiomers

(the L-AAs were ‘amplified’). These proposals will be critiqued in future papers, noting also that physically separated L-AAs in isolated crystals are unsuitable for any origin-of-life scenario. They need to redissolve, where remixing simply soon regenerates the racemic mixture.

The theoretical availability of biogenic AAs having *ee_L* <<10^{−7} would be utterly inadequate to produce peptides with any kind of secondary structure, a minimum requirement to form stable folded proteins. Forming the smallest biologically relevant secondary protein features requires on average about 95% pure L-AAs.⁵⁰

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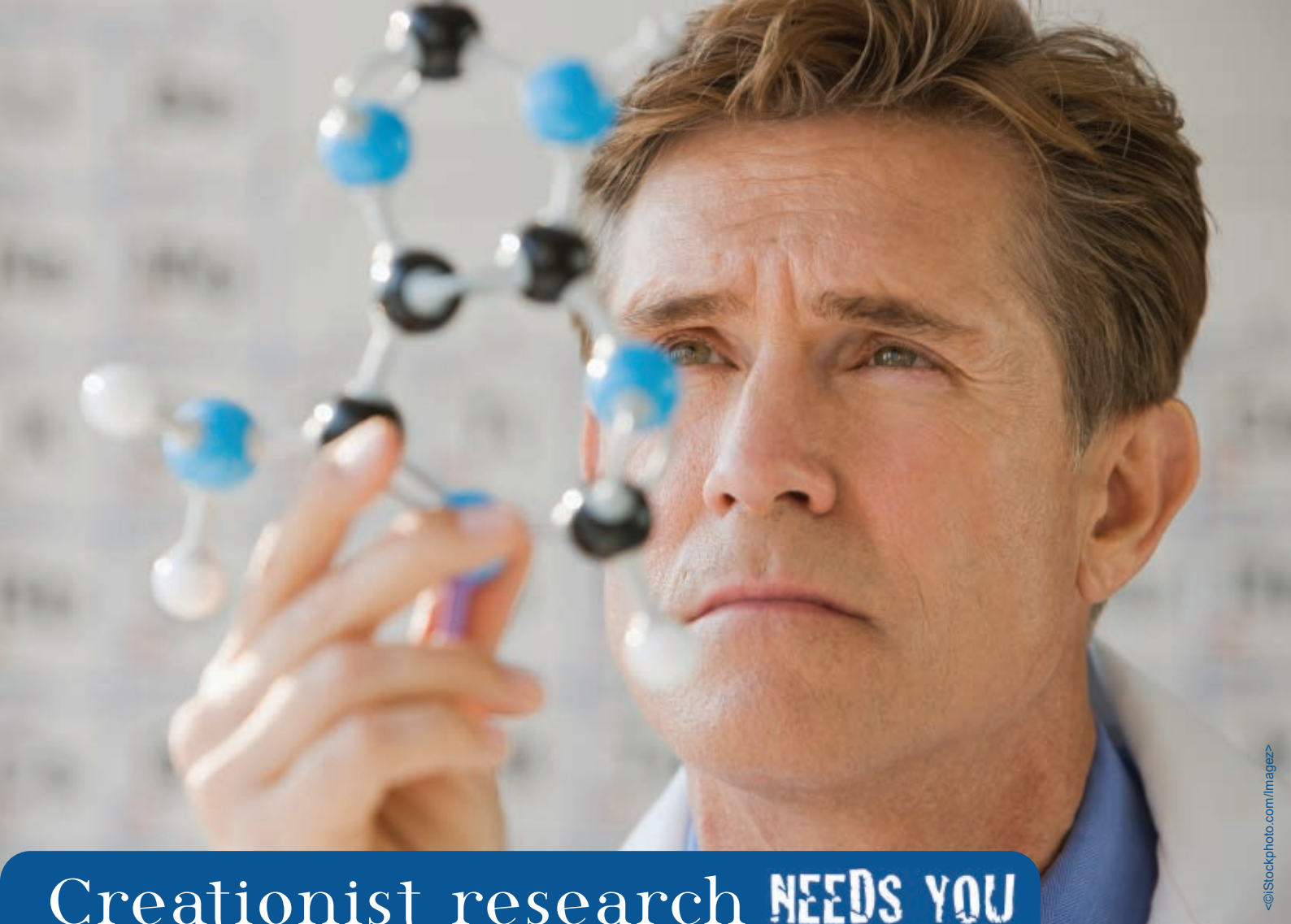
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